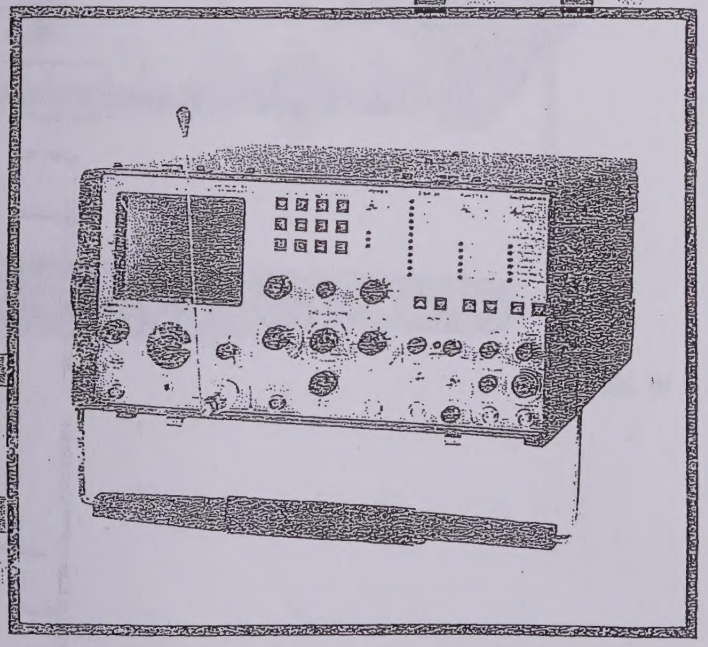
ESC-0978-92-01

MOTOROLA
test equipment

# COMMUNICATIONS SYSTEM ANALYZER

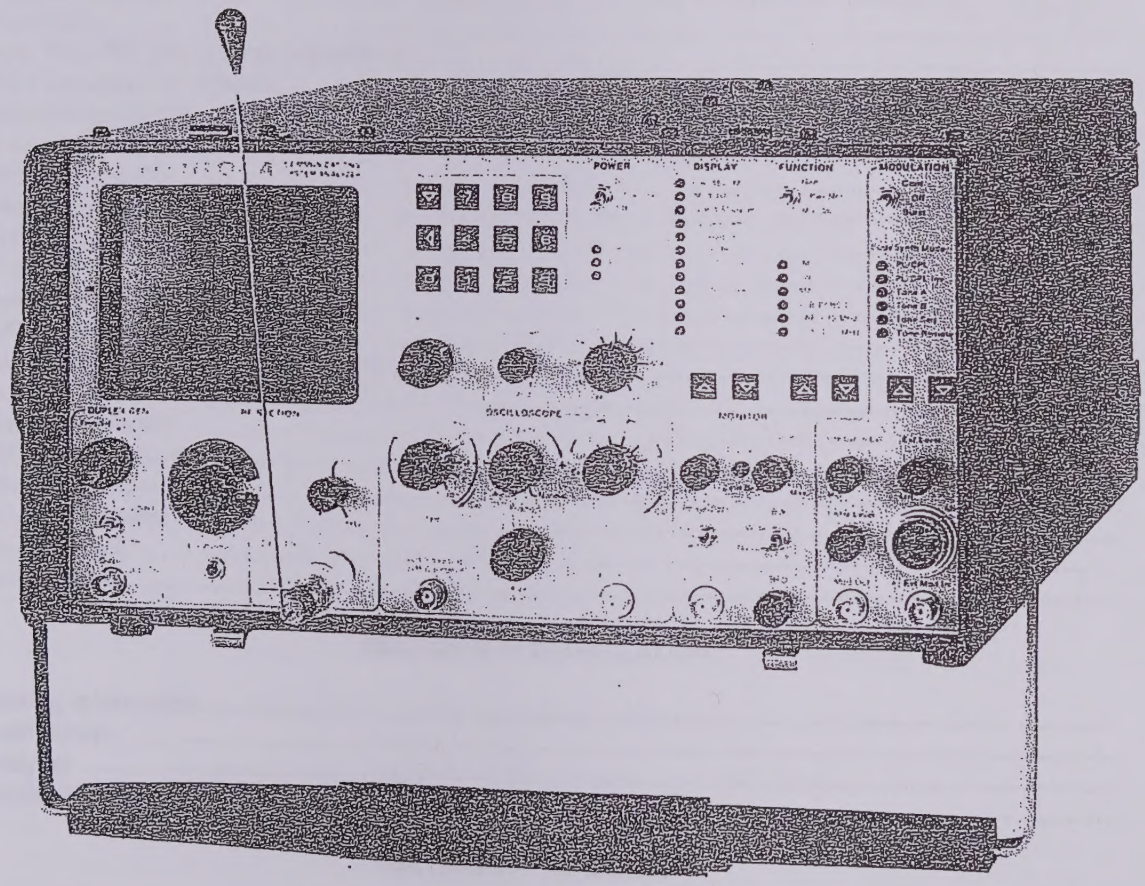


R-2001C/R-2002C

68P81069A99-O

*Communications Group*

# R-2001C/R-2002C COMMUNICATIONS SYSTEM ANALYZER



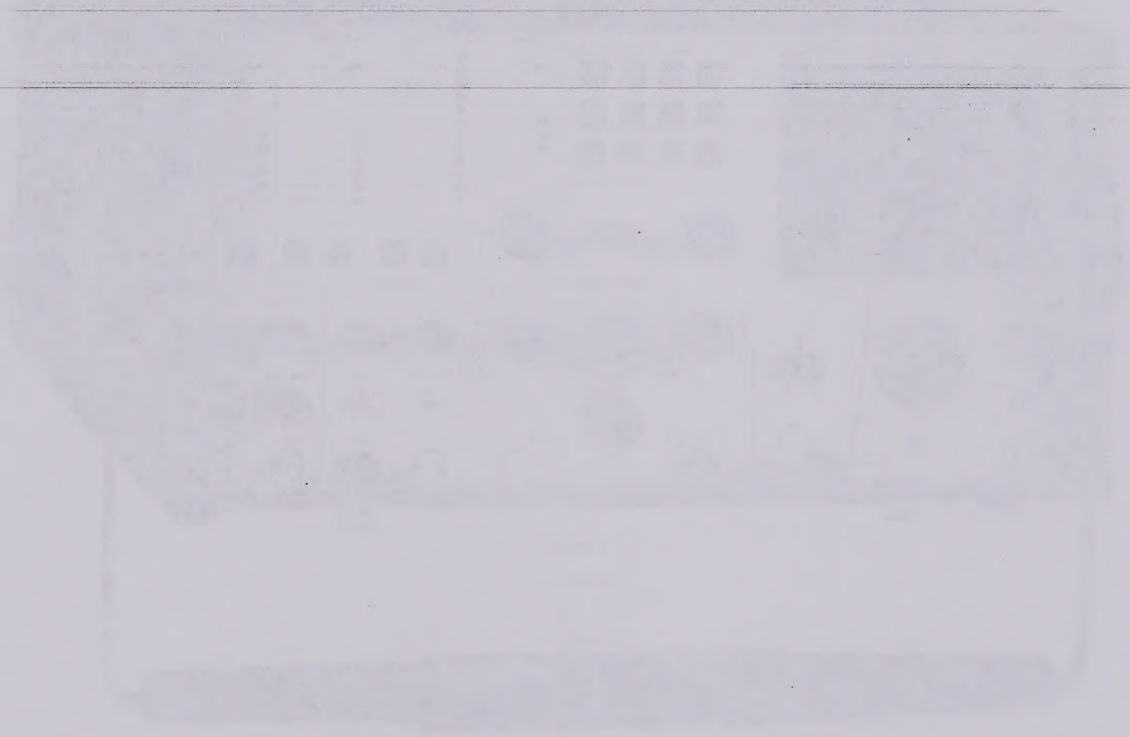

82-2948

8486-10

© Motorola, Inc. 1982
All Rights Reserved
Printed in U.S.A.

1313 E. Algonquin Road, Schaumburg, Il 60196

68P81069A99-O
12/1/82-SK



# TABLE OF CONTENTS


| Paragraph | | Page |
|---|---|---|
| | FOREWORD | 1 |
| | **SECTION 1** | |
| 1-1 | Introduction | 1-1 |
| | **SECTION 2 — DESCRIPTION** | |
| 2-1 | Description | 2-1 |
| 2-3 | Microprocessor | 2-1 |
| 2-4 | Display | 2-1 |
| 2-5 | System Warnings | 2-1 |
| 2-6 | Functions | 2-2 |
| 2-7 | AM, FM, CW, DSB Signal Generation | 2-2 |
| 2-8 | Simultaneous Modulation | 2-2 |
| 2-9 | Modulation Display | 2-2 |
| 2-10 | Sweep Generation | 2-2 |
| 2-11 | SINAD Metering | 2-2 |
| 2-12 | Multi-Mode Code Synthesizer | 2-2 |
| 2-13 | Off-The-Air Monitor | 2-2 |
| 2-14 | IF Display | 2-2 |
| 2-15 | Spectrum Analyzer | 2-2 |
| 2-16 | RF Burnout Protection | 2-3 |
| 2-17 | Terminated RF Power Measurement | 2-3 |
| 2-18 | In-Line Power Measurement | 2-3 |
| 2-19 | Duplex Generator | 2-3 |
| 2-20 | 500-kHz Oscilloscope | 2-3 |
| 2-21 | Frequency Counter | 2-3 |
| 2-22 | AC/DC Voltmeter | 2-3 |
| 2-23 | Power Supply | 2-4 |
| 2-24 | Accessories | 2-4 |
| | **SECTION 3 — INSTALLATION** | |
| 3-1 | Packing Information | 3-1 |
| 3-4 | Initial Setup | 3-1 |
| 3-5 | Analyzer | 3-1 |
| 3-6 | Battery Pack | 3-2 |
| | **SECTION 4 — OPERATION** | |
| 4-1 | General | 4-1 |
| 4-3 | Controls, Indicators, and Connectors | 4-1 |
| 4-5 | Operation | 4-12 |
| 4-7 | Calibrate | 4-12 |
| 4-8 | Generator Operation | 4-13 |
| 4-9 | Duplex Generation | 4-13 |
| 4-10 | Frequency Counter | 4-14 |
| 4-11 | Spectrum Analyzer | 4-14 |

4-12 Monitor ..... 4-15
4-13 Ext Wattmeter ..... 4-16
4-14 Simultaneous Generate and Measurement Operations ..... 4-17

## SECTION 5 — MAINTENANCE

5-1 Service ..... 5-1
5-6 Replacement Parts Ordering ..... 5-1
5-9 Addresses ..... 5-1
5-10 General Offices ..... 5-1
5-11 U.S. Orders ..... 5-2
5-12 Canadian Orders ..... 5-2
5-13 All Countries Except U.S. and Canada ..... 5-2
5-14 Major Assemblies ..... 5-3
5-16 Theory of Operation ..... 5-5
5-17 General ..... 5-5
5-20 System Control ..... 5-9
5-25 Generate Mode ..... 5-9
5-34 Power Meter ..... 5-12
5-40 Monitor Mode ..... 5-13
5-52 Duplex Generator ..... 5-14
5-56 Code Synthesizer ..... 5-15
5-65 Frequency Counter ..... 5-17
5-71 Digital Voltmeter (DVM) ..... 5-18
5-82 Distortion/SINAD Meter ..... 5-19
5-84 Oscilloscope ..... 5-19
5-96 Alignment Procedure ..... 5-21
5-97 Introduction ..... 5-21
5-99 Test Equipment Required ..... 5-21
5-101 Preparation for Alignment ..... 5-22
5-102 Basic Alignment Procedure ..... 5-22
5-115 Extended Alignment Procedure ..... 5-26
5-118 Distortion/SINAD Alignment ..... 5-29
5-123 Checkout Procedure ..... 5-30
5-124 Introduction ..... 5-30
5-126 Test Equipment Required ..... 5-31
5-128 Procedure ..... 5-31
5-143 System Troubleshooting ..... 5-35

## SECTION 6 — SYSTEM INTERCONNECT AND PARTS LISTS

## SECTION 7 — LOW VOLTAGE POWER SUPPLY (A1)

7-1 General ..... 7-1
7-2 Input Power Control ..... 7-1
7-6 DC Output Control ..... 7-1
7-9 Protection Circuitry ..... 7-1
7-13 High Voltage Supply Control ..... 7-2
7-14 Switcher Module A1A1 ..... 7-2
7-17 Output Module A1A2 ..... 7-2
7-21 Control Module A1A3 ..... 7-3
7-24 Relay Module A1A4 ..... 7-3

## SECTION 8 — SCOPE AMPLIFIER (A2)


| | | |
|---|---|---|
| 8-1 | General | 8-1 |
| 8-2 | Deflection Amplifiers | 8-1 |
| 8-3 | Horizontal Timebase Generator | 8-1 |
| 8-5 | Horizontal Switching | 8-1 |
| 8-6 | Intensity Control | 8-1 |
| 8-8 | Focus Control | 8-1 |
| 8-9 | Astigmatism, Geometry, and Trace Rotation | 8-1 |


## SECTION 9 — SCOPE/DVM CONTROL MODULE (A3)


| | | |
|---|---|---|
| 9-1 | General | 9-1 |
| 9-4 | Scope Vertical Control | 9-1 |
| 9-7 | SSB Detection | 9-1 |
| 9-8 | 455 kHz PLL | 9-1 |
| 9-9 | Scope Horizontal Control | 9-2 |
| 9-11 | Synthesizer Sweep Control | 9-2 |
| 9-12 | Scope Z-Axis Control | 9-2 |
| 9-13 | Modulation Display Control | 9-2 |
| 9-17 | Peak Detector | 9-2 |
| 9-18 | DVM Control | 9-2 |
| 9-21 | External DVM/Distortion Control | 9-3 |
| 9-22 | Distortion Measurement | 9-3 |
| 9-23 | External DVM Measurement | 9-3 |
| 9-24 | Module Control | 9-3 |


## SECTION 10 — RECEIVER (A4)


| | | |
|---|---|---|
| 10-1 | General | 10-1 |
| 10-2 | Down Converter | 10-1 |
| 10-4 | Linear IF Amplifier and Detectors | 10-1 |
| 10-8 | Audio Switching and Filtering | 10-1 |
| 10-10 | Logarithmic Amplifier and Detector | 10-2 |
| 10-11 | Alarm Generator and Audio Amplifier | 10-2 |
| 10-12 | Module Control | 10-2 |


## SECTION 11 — RF SYNTHESIZER (A5)


| | | |
|---|---|---|
| 11-1 | General | 11-1 |
| 11-2 | Frequency Synthesis Scheme | 11-1 |
| 11-5 | 310-440 MHz Phase Locked Loop | 11-1 |
| 11-6 | 60.5 MHz Phase Locked Loop | 11-1 |
| 11-7 | 550 MHz Phase Locked Loop | 11-1 |
| 11-9 | 500-1000 MHz Phase Locked Loop | 11-1 |
| 11-10 | Modulation Control | 11-2 |
| 11-11 | Module Control | 11-2 |


## SECTION 12 — AUDIO SYNTHESIZER (A6)


| | | |
|---|---|---|
| 12-1 | General | 12-1 |
| 12-2 | Private Line Generator | 12-1 |
| 12-7 | DPL Generator | 12-1 |
| 12-10 | 1 kHz Tone | 12-2 |

12-11 External Modulation ..... 12-2
12-12 Modulation Control ..... 12-2
12-14 Module Control ..... 12-2

## SECTION 13 — PROCESSOR I/O MODULE (A7)

13-1 General ..... 13-1
13-2 10.245 MHz Phase Locked Loop ..... 13-1
13-3 System Control Bus Interface ..... 13-1
13-6 A/D Converter ..... 13-1
13-7 External DVM ..... 13-2
13-10 Internal DVM ..... 13-2
13-11 Distortion Reading ..... 13-2
13-12 Frequency Counter ..... 13-2

## SECTION 14 — IEEE INTERFACE MODULE (A8)

14-1 General ..... 14-1
14-2 IEEE Bus Interface ..... 14-1
14-3 RF Level Control ..... 14-1
14-5 Modulation Control ..... 14-1
14-6 Address Decode and Control Latches ..... 14-1

## SECTION 15 — PROCESSOR MODULE (A9)

15-1 General ..... 15-1
15-2 Processor and Buffer ..... 15-1
15-3 Program Memory (ROM) ..... 15-1
15-4 Nonvolatile Memory (NVM) ..... 15-1
15-5 Random Access Memory (RAM) ..... 15-1
15-6 Peripheral Interface Adapter (PIA) ..... 15-1
15-7 Timing Generator ..... 15-1
15-8 Character Generator ..... 15-1

## SECTION 16 — HIGH VOLTAGE POWER SUPPLY (A10)

16-1 General ..... 16-1
16-2 High Voltage Supply ..... 16-1

## SECTION 17 — RF INPUT MODULE (A11)

17-1 General ..... 17-1
17-2 Input Protection and Power Meter ..... 17-1
17-4 Wideband Amplifier and Frequency Converter ..... 17-1
17-9 Duplex Generator ..... 17-2

## SECTION 18 — FRONT PANEL INTERFACE MODULE (A12)

18-1 General ..... 18-1
18-2 Input Coupling and Ranging ..... 18-1
18-4 DVM Buffer ..... 18-1
18-5 Frequency Counter Preamp ..... 18-1
18-6 Scope Vertical Preamp ..... 18-1
18-7 Scope Horizontal Preamp ..... 18-1
18-8 Control and Display Interface ..... 18-1

## SECTION 19 — 10 MHz FREQUENCY STANDARD MODULE (A13)


19-1 General ..... 19-1


## SECTION 20 — FRONT PANEL (A14)


20-1 General ..... 20-1
20-2 Display Board ..... 20-1


## SECTION 21 — IEEE-488 BUS CONTROL


21-1 Introduction ..... 21-1
21-7 IEEE-488 Bus Structure ..... 21-3
21-9 Bus Signals ..... 21-3
21-10 Data Transfer ..... 21-3
21-12 Programming ..... 21-3
21-15 Command Structure ..... 21-4
21-24 Command Strings ..... 21-7
21-25 Command Types ..... 21-7
21-29 Trigger Command ..... 21-7
21-30 Return Data ..... 21-7
21-35 Programming Commands ..... 21-8
21-36 Terminal Mode ..... 21-8
21-42 Error Messages ..... 21-8
21-45 Service Requests ..... 21-10
21-46 Programming Considerations ..... 21-11
21-53 General ..... 21-12
21-54 R2002C Analyzer Configuration ..... 21-12


## SECTION 22 — BATTERY ASSEMBLY

# LIST OF ILLUSTRATIONS


| Figure | | Page |
|---|---|---|
| 1-1 | Communications System Analyzer | 1-0 |
| 2-1 | Accessories Supplied with Analyzer | 2-4 |
| 3-1 | Typical Communication System Analyzer Packaging | 3-1 |
| 4-1 | Controls, Indicators, and Connectors, Front Panel | 4-2 |
| 4-2 | Controls, Indicators, and Connectors, Left Side Panel | 4-3 |
| 4-3 | Controls, Indicators, and Connectors, Rear Panel | 4-3 |
| 4-4 | System Analyzer Time Base Calibrate Test Setup and CRT Display | 4-12 |
| 4-5 | Duplex Generation Test Setup and CRT Display | 4-14 |
| 4-6 | Spectrum Test Setup and CRT Display | 4-15 |
| 4-7 | Wattmeter Test Setup and CRT Display | 4-16 |
| 4-8 | Test Setup for FM Receiver Sensitivity Using Generator and SINAD Meter with CRT Display | 4-17 |
| 4-9 | Test Setup for Two-Tone Pager and Alert Functions with CRT Display | 4-18 |
| 4-10 | Test Setup for 5/6 Tone Pager with CRT Display | 4-19 |
| 4-11 | Test Setup for Mobile Telephone Test with CRT Display | 4-20 |
| 4-12 | Test Setup for Select V Test with CRT Display | 4-12 |
| 4-13 | Test Setup for Using DVM and Signal Generate with CRT Display | 4-21 |
| 5-1 | Communication System Analyzer, Top View Cover Removed | 5-4 |
| 5-2 | Communication System Analyzer, Bottom View Cover Removed | 5-5 |
| 5-3 | Communication System Analyzer Block Diagram | 5-7 |
| 5-4 | Generate Mode Block Diagram | 5-11 |
| 5-5 | Power Meter Block Diagram | 5-12 |
| 5-6 | Monitor Mode Block Diagram | 5-13 |
| 5-7 | Duplex Generator Block Diagram | 5-15 |
| 5-8 | Code Synthesizer Block Diagram | 5-16 |
| 5-9 | Frequency Counter Block Diagram | 5-17 |
| 5-10 | Digital Voltmeter (DVM) Distortion Analyzer | 5-18 |
| 5-11 | Oscilloscope Block Diagram | 5-20 |
| 5-12 | Scope Amplifier Alignment Points | 5-24 |
| 5-13 | Front Panel Interface Alignment Points | 5-24 |
| 5-14 | Scope/DVM Control Alignment Points | 5-25 |
| 5-15 | Horizontal Time Base Alignment Points | 5-26 |
| 5-16 | Processor I/O A/D Alignment Points | 5-28 |

## LIST OF TABLES


| Table | | Page |
|---|---|---|
| 1-1 | Physical Characteristics | 1-1 |
| 1-2 | Electrical Characteristics | 1-1 |
| 1-3 | Input/Output Characteristics | 1-5 |
| 2-1 | Accessories Supplied with the Communication Systems Analyzer | 2-4 |
| 2-2 | Optional Equipment for Use with Analyzer | 2-5 |
| 4-1 | Controls, Indicators, and Connectors | 4-1 |
| 5-1 | List of Subassemblies | 5-3 |
| 5-2 | Control Buses and Functions | 5-10 |
| 5-3 | Basic Test Equipment Required | 5-21 |
| 5-4 | Extended Test Equipment Required | 5-21 |
| 5-5 | Test Equipment | 5-31 |
| 5-6 | System Troubleshooting | 5-35 |
| 5-7 | Test Point Identification | 5-42 |
| 7-1 | Control Logic Functions | 7-3 |
| 9-1 | Internal DVM Inputs | 9-3 |
| 21-1 | IEEE-488 Interface Controllable Functions | 21-2 |
| 21-2 | Command Categories | 21-4 |
| 21-3 | Programming Commands | 21-5 |
| 21-4 | Terminal Mode ASC II Characters Printable Characters | 21-9 |
| 21-5 | Error Messages | 21-10 |
| 21-6 | SRQ Data | 21-10 |
| 21-7 | Code Synthesizer Programming Considerations | 21-11 |

# FOREWORD

## 1. SCOPE OF MANUAL

This manual contains information for the installation, operation, and maintenance of the Communications System Analyzer.

## 2. PURPOSE AND USE

The Motorola Communications System Analyzer is a portable test instrument, designed specifically for the service and monitoring of communications equipment. Its functions supersede those of a Service Monitor, expanding the features and capabilities to the point wherein servicing is achieved with a single instrument, rather than a host of separate equipment.

The R2001C is the standard Communications System Analyzer. The R2002C Analyzer, which contains the IEEE-488 Standard interface control bus, is also available. Programming for the R2002C is covered in Section 21 of this manual.

The Analyzer improves a technician's efficiency and accuracy and reduces servicing time.

The Communications System Analyzer performs the functions of signal generation, signal monitoring and the tests normally associated with the devices listed below.

- Spectrum Analyzer
- Duplex Generator
- Modulation Oscilloscope
- Frequency Counter
- AC/DC Digital Voltmeter
- RF Wattmeter
- General Purpose Oscilloscope
- Multi-Mode Code Synthesizer
- Distortion/SINAD Meter
- Sweep Generator

The Analyzer meets the shock and vibration requirements of EIA test RS152B, the same specifications met by Motorola mobile radios. This minimizes failure when the instrument is used in a mobile service van, and means it is as tough as the radios it services.

The Communications System Analyzer is designed to be serviced quickly and easily, should a breakdown occur. The majority of the circuitry is on twelve modular plug-in circuit boards which have built-in test points that aid in isolating a problem to a specific board. Simple plug-in replacement gets the instrument back in service.

**CAUTION**

This equipment contains parts that are subject to damage by static electricity. Proper precautions should be taken during handling.

**WARNING**

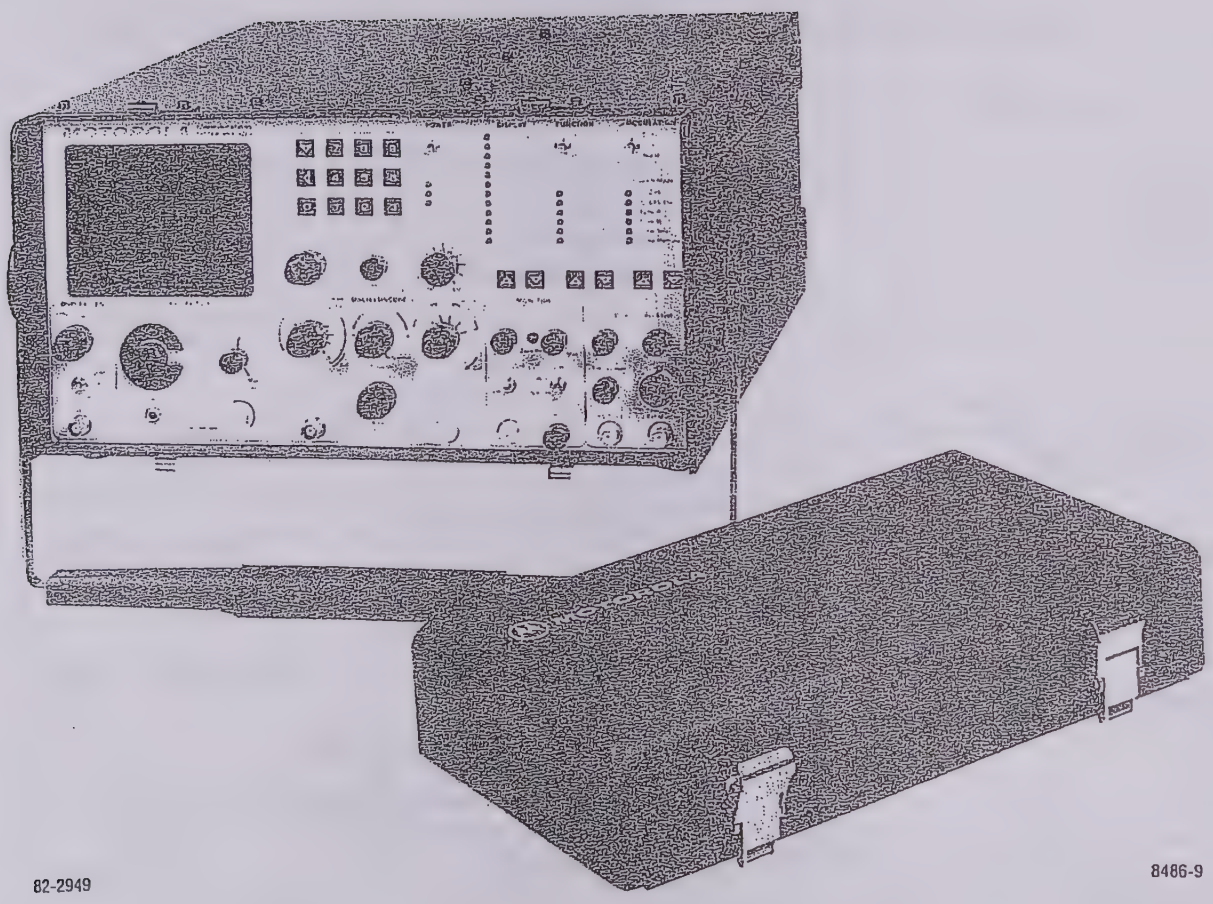
Lithium Battery

The processor module within this system utilizes a lithium battery as a memory keep-alive voltage source. Do not mutilate or disassemble the battery cell. The lithium metal is a very active material that burns in the presence of water or high humidity. Do not put the battery in fire, attempt to charge, heat above 100°C, or solder directly to the cell. Do not overdischarge the cell to a reverse voltage greater than 3 volts. The battery may burst and burn or release hazardous materials. See section 5-143 of this manual for battery troubleshooting procedures and cautions.

**CAUTION**

Lithium Battery

Lithium batteries are classified as hazardous materials and must be disposed of accordingly. Do not dispose of the battery by placing it in with the everyday trash. Consult state and local codes for the appropriate disposal procedure. Motorola will dispose of the battery if the expended battery is returned in the replacement battery container and by the same method that the new battery came to you, send to: Motorola Inc., Return Goods Department, 1313 East Algonquin Road, Schaumburg, Ill. 60196.



82-2949

8486-9

Figure 1-1. Communications System Analyzer

# SECTION 1

## 1-1. INTRODUCTION

1-2. This section lists the physical, electrical, and input/output characteristics of the Coummunications System Analyzer shown in figure 1-1.

Table 1-1. Physical Characteristics

| Characteristics | Description |
|---|---|
| Length | 20.75 inches (52.7 cm) |
| Width | 15.75 inches (40.0 cm) |
| Height | 8.25 inches (21.0 cm) |
| Weight | 48 pounds (21.9 kg) (Excluding Battery Pack) |

Table 1-2. Electrical Characteristics

| Characteristics | Description |
|---|---|
| **Signal Generator Mode** | |
| **Frequency** | |
| Range: | 10 kHz to 999,9999 MHz |
| Resolution: | 100 Hz |
| Accuracy: | Equal to master oscillator time base |
| **Output (into 50 ohms)** | |
| Attenuator: | 16 dB variable plus 10 dB steps over 13 ranges |
| Range: | 0.1$\mu$V to 1 Vrms (−127 dBm to +13 dBm) |
| Accuracy: | ±2 dB accuracy on 0 dB step attenuator range<br>±2 dB across other step attenuator ranges<br>±1 dB over temperature range |
| **Spectral purity** | |
| Spurious: | ≦−40 dB |
| Harmonics: | ≦−15 dB |
| **Frequency modulation** | |
| Range: | 0 - 50 kHz peak |
| Accuracy: | ±5% of full scale |
| FM residual noise: | 100 Hz |
| External/internal frequency range: | 5 Hz - 10 kHz (±1 dB) |
| External input: | Approximately 150 mV for 20 kHz deviation |
| Modes: | Internal, external, microphone or all simultaneously |

Table 1-2. Electrical Characteristics (Cont)

| Characteristics | Description |
|---|---|
| **Amplitude modulation** | |
| Range: | 0 to 80% from 1 to 500 MHz |
| Accuracy: | ±10% of full scale from 0% to 50% AM |
| External/internal frequency range: | 5 Hz - 10 kHz (±1 dB) |
| Modes: | Internal, external, microphone or all simultaneously |
| **Double sideband suppressed carrier** | |
| Carrier suppression: | ⩾25 dB (1 MHz - 500 MHz) |
| **Monitor Mode** | |
| **Frequency** | |
| Range: | 1 MHz to 999.9999 MHz |
| Resolution: | 100 MHz |
| Accuracy: | Equal to that of master oscillator time base |
| **Frequency error indicator** | Autoranging CRT display. ±10 Hz resolution for frequency error measurements on 1.5 kHz, 5 kHz and 15 kHz full scale ranges. ±1 Hz resolution on the 50 Hz full scale range. |
| **Input sensitivity** | 1.5 μV for 10 dB EIA Sinad (narrow band ±6 kHz mod. acceptance) 7 μV for 10 dB EIA Sinad (wide band ±100 kHz mod. acceptance) 4 MHz to 1000 MHz. Useable to 1 MHz. |
| **Spurious response** | −40 dB typical<br>0 dB image at ±21.4 IMHz<br>−10 dB at L.O. harmonics ±10.7 MHz |
| **Deviation Measurement** | |
| Range: | 1, 10, 100 kHz full scale |
| Accuracy: | ±5% of reading ± 100 kHz from 500 Hz to 50 kHz deviation;<br>±10% of reading from 50 kHz to 75 kHz deviation |
| Peak deviation limit alarm: | Set via keyboard to 100 Hz resolution (0.1 kHz to 99.9 kHz). Audible alarm indicates limit condition in all Monitor Modes. 00.0 setting disables the alarm. |
| **AM modulation measurement** | |
| Range; | 0 to 100% |
| Accuracy: | ±5% of full scale |
| **RF Wattmeter (Autoranging display)** | |
| Frequency range: | 1 MHz to 1000 MHz |
| Power range: | 1.0 watts to 125 watts |
| Accuracy: | ±10%, 1 watt to 125 watts |
| Protection: | Over temp indicator |

Table 1-2. Electrical Characteristics (Cont)

| Characteristics | Description |
|---|---|
| **General**<br>**Spectrum Analyzer** | |
| **Dynamic range** | ⩾75 dB displayed, −105 dBm to −30 dBm input range with step attenuator |
| **Frequency** | |
| Range: | 4 MHz to 1,000 MHz |
| Full scale frequency dispersion: | Adjustable between 1 MHz and 10 MHz |
| **Duplex Generator** | |
| **Frequency offset** | Adjustable from 0 to 10 MHz plus fixed offset of 45 MHz (high or low side) |
| **Modulation level (FM only)** | Adjustable from 0 to 20 kHz peak deviation |
| **Oscilloscope** | |
| **Size** | 8 cm × 10 cm |
| **Frequency response** | DC to 0.5 MHz (3 dB point) |
| **External vertical input range** | 10 mV, 100 mV, 1V, 10V (per division) |
| **Sweep rates** | 1 μs, 10 μs, 0.1 ms, 1 ms 0.01S, 0.1S (per division) |
| **Sync** | Automatic, normal and delayed triggering. Delayed triggering is programmable to 10 seconds in 1 ms steps and works in conjunction with the code synthesizer. **See "CAUTION" note on page 4-19** |
| **Frequency Counter** | |
| **Frequency range** | 10 Hz to 35 MHz |
| Readout: | 5 digit, autoranging |
| Input sensitivity: | 30 mV from 10 Hz to 1 MHz<br>50 mV from 1 MHz to 35 MHz |
| **Digital Voltmeter** | |
| Readout: | Auto ranging digital display, 1, 10, 100, 300 volts full scale. AC-dBm calibrated across 600 ohms. |
| DC accuracy: | ±1% of full scale ±1 least significant digit |
| AC accuracy: | ±5% of full scale |
| AC bandwidth: | 50 Hz to 10 kHz |
| **Modulation Source** | |
| **Code Synthesizer** | |
| Frequency range: | 5 Hz to 9.9999 kHz sinewave |
| Resolution: | 0.1 Hz |
| Frequency accuracy: | ±0.01% |
| Distortion: | ⩽1% |

Table 1-2. Electrical Characteristics (Cont)

| Characteristics | Description |
|---|---|
| **Signaling Sequences** | |
| Two Tone A/B | Tone Only Sequence<br>Tone and Voice Sequence<br>Two user programmable<br>(See figure 1-2 for sequence timing) |
| 5/6 Tone | Digit Frequencies (See figure 1-3 for sequence timing)<br>0 - 600 Hz<br>1 - 741 Hz<br>2 - 882 Hz<br>3 - 1023 Hz<br>4 - 1164 Hz<br>5 - 1305 Hz<br>6 - 1446 Hz<br>7 - 1587 Hz<br>8 - 1728 Hz<br>9 - 1869 Hz<br>R - 459 Hz<br>X - 2010 Hz |
| **Mobile Telephone** | |
| IMTS | (See figure 1-4 for sequence timing) |
| MTS | (See figure 1-5 for sequence timing) |
| 2805 | (See figure 1-6 for sequence timing) |
| Select V<br>ZVEI | Tone length–70ms<br>Digit Frequencies<br>1 - 1060 Hz<br>2 - 1160 Hz<br>3 - 1270 Hz<br>4 - 1400 Hz<br>5 - 1530 Hz<br>6 - 1670 Hz<br>7 - 1830 Hz<br>8 - 2000 Hz<br>9 - 2200 Hz<br>0 - 2400 Hz<br>R - 2600 Hz |
| Modified ZVEI | Tone length - 70 ms<br>Digit Frequencies<br>1 - 970 Hz<br>2 - 1060 Hz<br>3 - 1160 Hz<br>4 - 1270 Hz<br>5 - 1400 Hz<br>6 - 1530 Hz<br>7 - 1670 Hz<br>8 - 1830 Hz<br>9 - 2000 Hz<br>0 - 2200 Hz<br>R - 2400 Hz |

Table 1-2. Electrical Characteristics (Cont)

| Characteristics | Description |
|---|---|
| CCIR (100 ms) | Tone length - 100 ms<br>Digit Frequencies<br>1 - 1124 Hz<br>2 - 1197 Hz<br>3 - 1275 Hz<br>4 - 1358 Hz<br>5 - 1446 Hz<br>6 - 1540 Hz<br>7 - 1640 Hz<br>8 - 1747 Hz<br>9 - 1860 Hz<br>0 - 1981 Hz<br>R - 2110 Hz |
| CCIR (70 ms) | Tone length - 70 ms<br>Digit Frequencies<br>Same as CCIR (100 ms) |
| EEA | Tone length - 40 ms<br>Digit Frequencies<br>Same as CCIR |
| **Tone remote access** | Remote base access sequence as follows<br>Tone A for 150 msec<br>Tone B for 40 msec 10 dB below Tone A<br>Tone A continuously 30 dB below the first Tone A burst |
| **Digital private line (DPL)** | Codes 000 to 777 and inverted |
| Fixed 1 kHz | |
| Accuracy: | Equal to master time base |
| Distortion: | ⩽1% |
| **External input** | |
| Microphone: | Standard RTM 4000A microphone interface with IDC. |
| External Jack | |
| Frequency range: | 5 Hz to 10 kHz |
| level: | 7 vrms maximum |
| Impedance: | 10K ohm nominal |
| **Code synthesizer external output level** | 0-3 vrms into a 600 ohm load |
| **Distortion/SINAD Meter** | |
| **Input Frequency:** | 1 kHz ± 1 Hz |
| **Input level range:** | 0.5V to 10 Vrms |
| **Sinad accuracy:** | ±1 dB at 12 dB Sinad |
| **Distortion Accuracy:** | ±0.5% of Distortion for 1% ⩽ THD ⩽10%<br>±1% of Distortion for 10% ⩽THD ⩽20% |

Table 1-2. Electrical Characteristics (Cont)

| Characteristics | Description |
|---|---|
| **Manual Frequency Scan** | |
| **Step size** | Switch Selectable: 100 Hz, 1 kHz, 10 kHz, 100 kHz and 1 MHz (+ or −) |
| **Step rate** | 5 steps/sec |
| **Time Base** | |
| **Standard TCXO** | Aging: $\pm 1 \times 10^{-6}$ per year<br>Temp: $\pm 1 \times 10^{-6}$ maximum error over the 0° to 55°C temp range |
| **Optional ovenized high stability** | Aging: $\pm 1 \times 10^{-6}$ per year<br>Temp: $\pm 5 \times 10^{-8}$ maximum error over the 0° to 55°C temp range<br>(warmup to $\pm 5 \times 10^{-7}$ of final frequency within 20 minues) |
| **Power and Environmental** | |
| **AC** | 100-130 VAC, 200-260 VAC 47-63 Hz |
| **DC** | +11.5 VDC to + 16 VDC |
| Optional battery | 13.6V battery – provides 1 hour continuous operation |
| **Temperature range** | 0° to 55°C operation; −40° to 85°C storage |

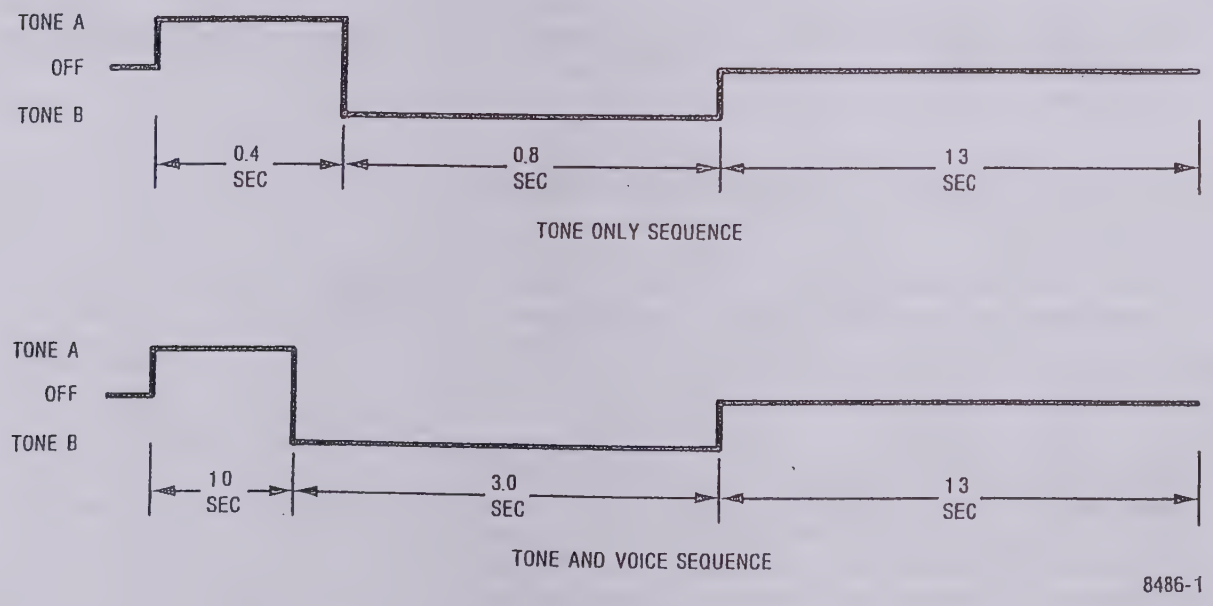



Figure 1-2. Two Tone (A/B) Sequence Timing

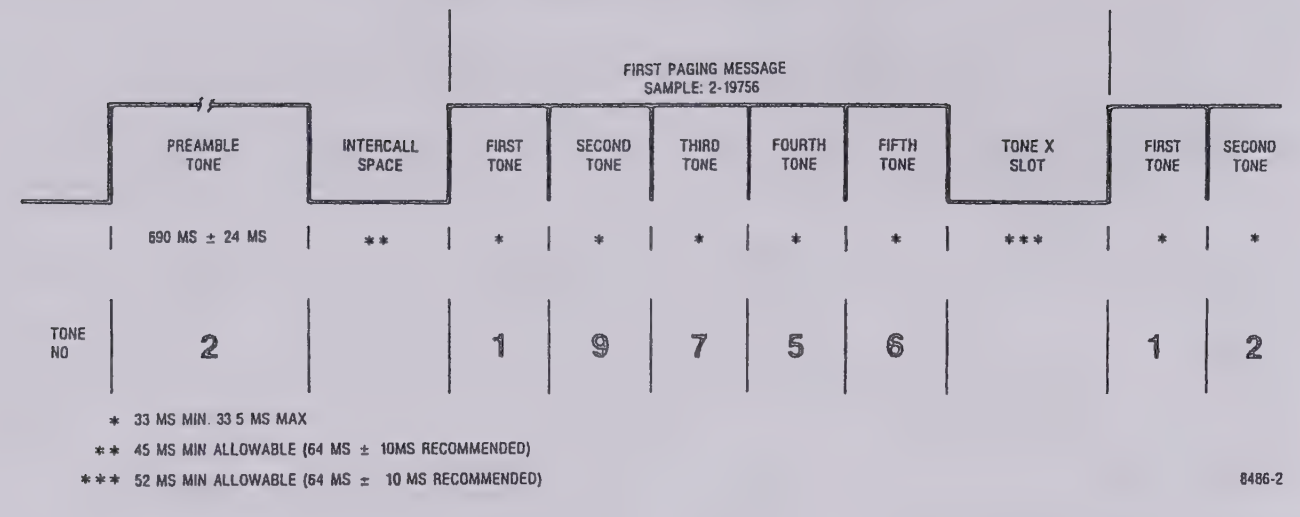



Figure 1-3. 5/6 Tone Squence Timing

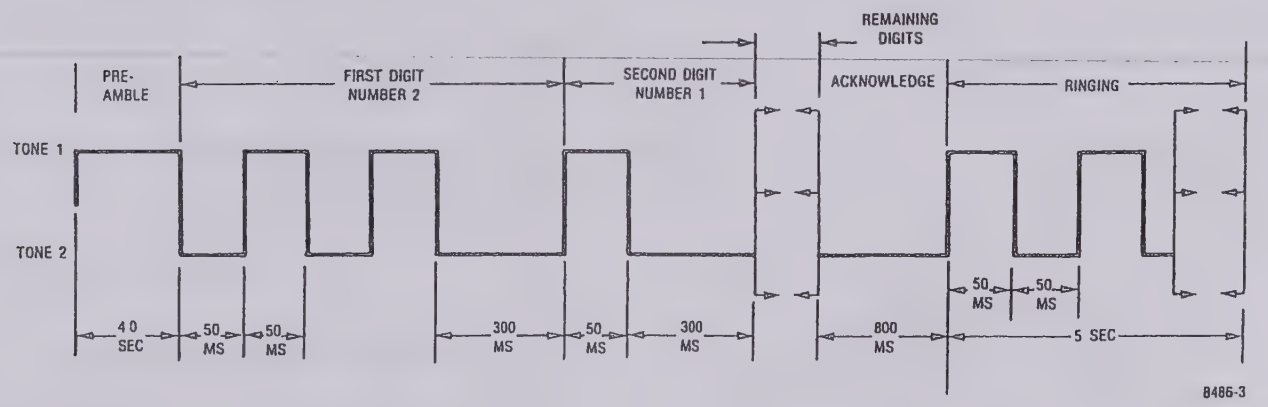



Figure 1-4. IMTS Sequence Timing

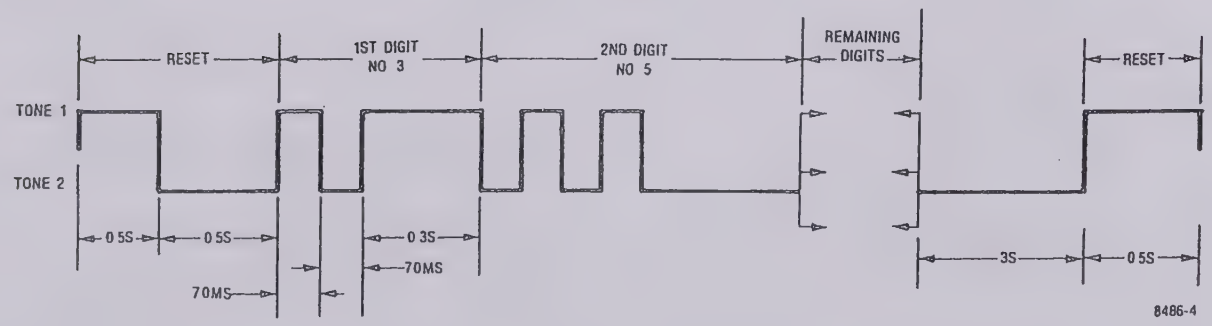



Figure 1-5. MTS Sequence Timing

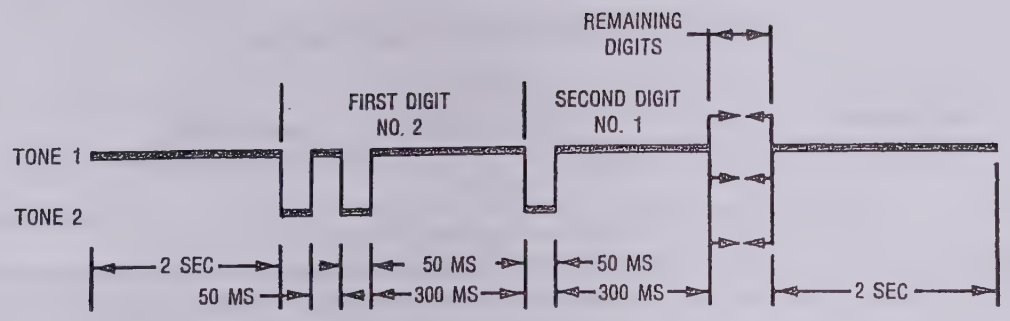



Figure 1-6. 2805 Sequence Timing

Table 1-3. Input/Output Characteristics

| Characteristic | Description |
|---|---|
| **Input** | |
| Ext Mod in | 10K ohms nominal, 150 mV typical for 20 kHz dev. FM or 80% AM |
| Mic. | Mic input provides bias and IDC limiting suitable for Motorola RTM 9000A handset. PTT switches R2001 from monitor to generate. |
| Ext Horiz<br>Vert/SINAD/Dist/DVM/Counter In | 1 volt minimum for full screen deflection. Maximum input 10 volts.<br>1 Meg ohm, 40 pf Nominal; ±300 volts DC max, 300 Vrms max at frequencies below 500 Hz, 10 Vrms max up to 35 MHz<br>• Scope vert in: DC to 500 kHz or 50 Hz to 500 kHz AC mode (±3 dB)<br>• Distortion/Sinad in: 0.5 to 10 Vrms in at 1 kHz<br>• DVM in: 1, 10, 100 and 300V full scale AC (true RMS) or DC. AC bandwidth 50 Hz to 10 kHz for ±5% F.S. accuracy (AC dBm calibrated across 600 ohms)<br>• Frequency counter in: 30 mV or greater required from 10 Hz to 1 MHz, 50 Mv or greater required from 1 MHz to 35 MHz |
| RF In/Out | 50 ohms nominal, 125 watts max (1-1000 MHz)<br>**CAUTION:**<br>The RF In/Out Jack is protected against RF overload. However, to prevent undue stress on the protected circuits it is advisable to always switch the system to the power monitor mode before applying power in excess of 200 mV. Additional protection is also obtained by making it a practice not to leave the step attenuator in the 0 dB position. |
| Ext Wattmeter | Characteristics suitable for Motorola ST-1200 series Wattmeter Elements |
| 10 MHz std in (rear panel) | 70 to 350 mV rms input required at 10 MHz, impedance greater than 50 ohms. |

Table 1-3. Input/Output Characteristics (Cont)

| Characteristic | Description |
|---|---|
| **Output** | |
| Mod out | Up to 11 vpp into 600 ohms 10 Hz to 10 kHz |
| Demod out | Typically 3 vpp into 600 ohms for ±5 kHz deviation narrowband, 4 vpp for ±75 kHz deviation wideband. DC to 10 kHz response |
| RF in/out | 1.0 Vrms (+13 dBm) to 0.1 μVrms (−127 dBm) 50 ohm nominal source impedance. 10 kHz to 1.0 GHz. |
| Duplex gen out | −30 dBm typical, 50 ohm nominal source impedance 2 MHz to 1 GHz |
| 10 MHz std out (rear panel) | 250 mV rms nominal output into 50 ohms |

# SECTION 2
# DESCRIPTION

## 2-1. DESCRIPTION

2-2. The Communication System Analyzer is a portable test instrument designed for servicing and monitoring of portable, mobile, and land base communications equipment operating over the frequency range of 1 MHz to 1 GHz. The unit performs the functions of signal generation, frequency error and modulation measurement. It is also capable of a variety of tests normally associated with the following devices:

- Spectrum analyzer
- Duplex offset generator
- Modulation oscilloscope
- Frequency counter
- AC/DC digital-analog voltmeter
- RF wattmeter
- General purpose oscilloscope
- Multi-mode code synthesizer
- Distortion/SINAD meter
- Sweep generator

2-3 MICROPROCESSOR. A Motorola M-6800 series microprocessor permits keyboard entry of data, autoranging of displays, fast frequency access, and permanent storage of often-used frequencies and codes. Generate and monitor RF frequencies, tone codes, and timing sequences can be programmed into a nonvolatile memory, saving time and eliminating entry errors. When one particular type of equipment is continuously serviced, the unit can be programmed to select the mode of operation required when first turned on.

2-4. DISPLAY. All functions, generated or monitored, are presented on an 8 cm x 10 cm cathode ray tube (CRT) in both analog and digital format, with the name of the function being displayed. The CRT also displays control settings eliminating the need for operator search of different equipment panels. Digital readouts are visually aided by the use of the continuously autoranging analog line segments, which are similar to a bar graph. Each has a base line and calibration markers, in addition to the intensified segment showing the measurement. The user selectable displays are listed in a column beneath the DISPLAY heading on the front panel. Choosing a display is accomplished by pressing an arrow button below the column, for up or down movement, as required. When the appropriate arrow is pressed, the LED adjacent to the selected display illuminates. FUNCTION is selected in the same way, providing rapid, accurate changes in service capability at the touch of a button.

2-5. SYSTEM WARNINGS. To aid the technician in servicing, visual warnings will appear on the CRT when certain overload or caution conditions exist. Displays warn of low battery power, overheating of the RF load, or an improper attenuator setting for particular measurements. In addition, a continuous audible alarm sounds when a preset deviation limit is exceeded in monitor modes. This limit is entered by using the keyboard and may be programmed from 0.1 KHz to 99.9 kHz, with 100 Hz resolution.

**2-6. FUNCTIONS.** The following paragraphs briefly describe the major functions of the Communications System Analyzer.

**2-7. AM, FM, CW, DSB Signal Generation.** The built-in general purpose signal generator provides continuous coverage of the HF, VHF, and UHF land mobile spectrum for receiver testing. Many forms of external and interna modulation can be simultaneously impressed on the carrier signal for actual composite signals. The frequency range of the RF signal generator is from 10 kHz to 1000 MHz in 100 Hz steps. The output of up to 1 Volt rms provides sufficient amplitude to get through misaligned tuners and receivers, and is especially effective when changing a receiver's frequency. The high level, clean output is available over the entire frequency range of the Communications System Analyzer. The output frequency is referenced to an internal time base which can be calibrated to the WWV Standard. (See paragraph 4-7.)

**2-8. Simultaneous Modulation.** Modulation is simultaneously available from an internal 1 kHz tone generator, a multi-mode code synthesizer, and from external inputs. The external modulation can be voice from a standard Motorola mobile radio microphone (which plugs into the front panel of the instrument), as well as a signal applied to the external BNC input. Separate controls are provided for independently setting the levels of the 1 kHz tone, the code synthesizer, and the external modulation sources. The 1 kHz test tone is a convenient source of modulation for making SINAD (signal to noise and distortion) measurements. A MOD OUT connector provides external access to all of the modulation signals.

**2-9. Modulation Display.** The recovered audio waveform, or audio used to modulate the generator carrier can be viewed on the CRT. It is used to graphically measure deviation, and to aid in waveform analysis.

**2-10. Sweep Generation.** The sweep generator mode provides an RF output that is swept in frequency across a band centered at the programmed frequency. A synchronized horizontal sweep for the internal oscilloscope allows filter characteristics to be easily determined. This is ideal for in-depth troubleshooting of IF amplifiers and filters.

**2-11. Distortion/SINAD Metering.** A comprehensive check of receiver performance can be made with the Distortion/SINAD meter. An analog line segment and digital display of distortion and SINAD are automatically displayed on the CRT in the normal generate display or can be called up in the DVM display. The only hookups required are from the R2001C RF output to the RF input of the receiver under test, and from the receiver audio output to the R2001C SINAD input. The measurement and appropriate servicing can then be accomplished without the need for a separate signal generator, SINAD meter and distortion analyzer.

**2-12. Multi-Mode Code Synthesizer.** The Communications System Analyzer generates Private Line tones (PL), Digital Private Line codes (DPL), multi-tone sequential paging codes and tone-remote base signaling tones. All codes are available at the Mod Out jack, as well as being used internally to modulate the RF signal generator. This eliminates the necessity of using separate generators and oscillators for general servicing, setting transmitter deviation, or for checking tone-remote-base control lines. Time sequences are also stored in the Tone Memory to provide fast set-up and to eliminate errors. User programmable two-tone timing sequences are also provided to allow the storage of non-standard or future time sequences.

**2-13. Off-the-Air Monitor.** The 1.5$\mu$V sensitivity of the Communications System Analyzer receiver allows off-the-air-monitoring and measurement of transmitter frequency error and deviation to 1000 MHz. A variable squelch allows weak signals to be monitored, but can be set higher to ensure the proper signal-to-noise ratio for measurement accuracy. The off-the-air monitor function enables frequent parameter checks without leaving the shop, thus spotting system degradation early and keeping service costs down. Bandwidth can be set Wide for off-channel signal location or wide band FM; or Narrow for maximum sensitivity and selectivity.

**2-14. IF Display.** When the IF display mode is selected, the Communications System Analyzer's reciever IF envelope is shown on the CRT. This allows the technician to qualitatively and quantitatively assess the amplitude modulation envelope of a transmitter.

**2-15. Spectrum Analyzer.** In this mode of operation the CRT displays a window of the RF spectrum whose bandwidth (from 1 MHz to 10 MHz) is determined by the DISPERSION/SWEEP control. The center frequency of this

window ranges from 4 MHz to 1,000 MHz, selectable by entering a specific center frequency with the keyboard. This center frequency is digitally displayed at the top of the CRT screen, eliminating the need for an external signal generator, and counter to provide markers. Once a signal is centered on the screen, positive identification is aided by switching the Analyzer to MONITOR AM or FM and listening to the demodulated output via the built-in audio amplifier and speaker. The spectrum analyzer's center frequency can be scanned up or down at rates varying from 0.5 kHz per second to 5 MHz per second, using the RF scan control. Slow rates are used to precisely determine a subject signal's frequency while faster rates are used for locating intermittent transmissions or viewing large areas of the spectrum in a short time. Uses of the Spectrum Analyzer are: Intermodulation interference identification, IF and RF signal tracing, transmitter harmonics measurements, transmitter spurious checks, and receiver local oscillator radiation.

**2-16. RF Burnout Protection.** At RF input levels above 200 mW, in any operating mode, the input automatically switches to the internal 125 watt RF load, thus protecting the attenuator and signal generator against damage from a keyed transmitter. If power above 200 mW is applied in any mode except the power monitor mode and audible alarm sounds and a visual warning on the CRT directs the operator to switch to the power monitor mode.

**CAUTION**

To prevent undue stress on the protected circuits it is advisable to always switch the system to the power monitor mode before applying power in excess of 200 mW. Additional protection is also obtained by making it a practice not to leave the step attenuator in the 0 dB position.

**2-17. Terminated RF Power Measurement.** RF power is automatically measured when the Communications System Analyzer is in the Power-Monitor mode. The built-in RF load dissipates up to 50 watts for three minutes and up to 125 watts for one minute. If a high power transmitter should be keyed into the unit for a time long enough to threaten overheating of the power measuring circuitry, the audible alarm sounds and the CRT display changes to read RF LOAD OVER-TEMP, thus warning the technician to un-key. This instrument function is further enhanced by the simultaneous indication of RF power output, carrier frequency error, and modulation, all on the same CRT display.

**2-18. In-Line Power Measurement.** Use of the Motorola ST-1200 series Wattmeter elements in conjunction with the analyzer's external wattmeter display provides measurement of forward and reflected antenna power on the CRT display. This capability eliminates the complex hook-ups and the additional instruments normally required for antenna measurements.

**2-19. Duplex Generator.** In this mode, the Communications System Analyzer simultaneously receives and generates the signals for duplex radio servicing, while generated and monitored frequencies are observed on the CRT. In the 0-10 MHz range, the 'Freq. Set' control tunes the proper offset frequency for the VHF and UHF bands. The 45 MHz mode provides a single offset for the 800 MHz range A switch is also provided to select high or low side offset, as required. The Duplex Generator provides enhanced capability to service equipment such as repeaters, car telephones and Emergency Medical Telemetry portables.

**2-20. 500-kHz Oscilloscope.** This general purpose scope is ideal for waveform analysis in two-way communication servicing. Use it for viewing modulation signals (either internally or externally generated), detection of asymmetric modulation or audio distortion, and general purpose signal tracing and troubleshooting.

**2-21. Frequency Counter.** The frequency counter measures inputs in a range from 10 Hz to 35 MHz. Its 5 digit auto-ranging output is displayed on the CRT and allows precise measurement and setting of offset oscillators, 35 kHz and 455 kHz pager IF's, PL frequencies and other external input signals. This function will also operate simultaneously with the generator or monitor receiver modes of operation. Frequency measurement of transmitted carriers and other signals higher than 35 MHz is easily accomplished with the frequency error readout in the monitor modes.

**2-22. AC/DC Voltmeter.** Switching to the DVM mode provides a digital-analog voltage presentation on the CRT, along with the corresponding dBm value. The auto-ranging display provides full scale deflections of 1, 10, 100 and 300 Volts. AC or DC measurement is selected on the CRT. The meter's wide dynamic range and three digit display are ideal for setting power supply voltages, checking bias levels, and setting audio levels. Like the Frequency Counter, the DVM will operate simultaneously with generate or monitor operation.

2-23. **Power Supply.** The Communications System Analyzer may be powered by a variety of sources:

- AC at 110 or 220 Volts, 50, 60 Hz
- DC from an external 12 Volt source such as a service vehicle
- DC from an optional battery pack. Servicing can thus be accomplished wherever the equipment under test is located.

**2-24. ACCESSORIES.**

2-25. Figure 2-1 illustrates and Table 2-1 lists the accessories supplied with the Communication System Analyzer. Optional equipment available for use with the unit is listed in Table 2-2.

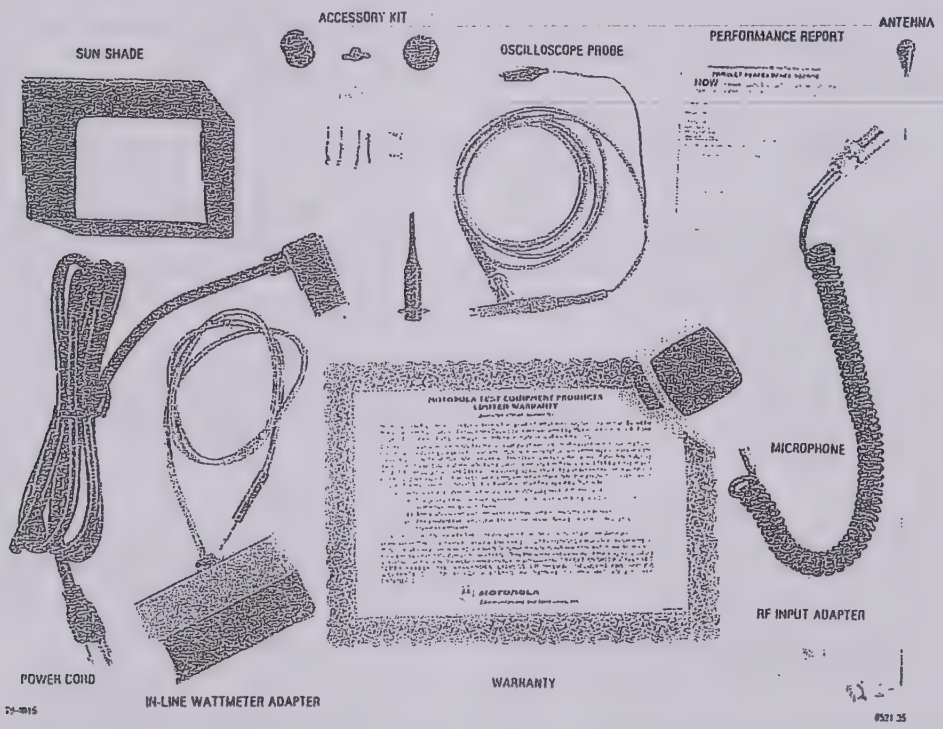



Figure 2-1. Accessories Supplied with Analyzer

Table 2-1. Accessories Supplied with the Communication Systems Analyzer

| Equipment | Motorola Part No. | Use |
|---|---|---|
| Front cover | 15-80335A70 | Front panel and CRT protection, storage of cables, power cord, and other equipment for on-site servicing. |
| Sun shade | 15-80335A55 | Snap over CRT during use in bright sunlight. |
| Power cord | 30-80336A36 | Three conductor cord to supply AC power to unit. Also used when charging optional battery pack. |
| Oscilloscope probe | RTL-4058A | A X1 probe with attachments for general servicing. |
| In-line wattmeter adapter | RTL-4055B | Allows use of Motorola ST-1200 series in-line wattmeter elements for direct measurement and display of forward and reflected transmitted power. |
| Coax adapter | 58-84300A98 | Adapts front panel "N" connector to BNC female. |
| Antenna | TEKA-24A | Plugs into RF in/out connector on front panel, with N to BNC adapter. Used for off-the-air transmitter and receiver tests. |
| Test microphone | RTM-4000A | Used for voice modulation of signals. |
| Connector kit | RPX-4097A | Consists of connector shell, clamp, and four connector pins. Used to fabricate a mating plug for male dc power connector at back of analyzer. Enables user to make a dc power cable to interconnect separate power source to analyzer. Pins 1 and 2 are positive, pin 3 is the charging line, pin 4 is ground. |

Table 2-2. Optional Equipment for Use with Analyzer

| Equipment | Motorola Part No. | Use |
|---|---|---|
| IEEE-488 Standard interface bus option | Consult factory for retrofit information. | Enables fully automatic testing with the unit by external control from a computer or programmable controller. |
| Battery pack | RTP-1002A | 13.6 volt battery and charger attaches to back of the unit. Provides one hour of continuous operation. Cannot be used with IEEE-488 option. |
| High-stability oscillator module | RTL-1007A | Improves stability of the time base as specified in electrical characteristics section. |
| Protective cover | RTL-4056A | Padded fabric type cover to protect unit from excessive field wear. |

# SECTION 3
# INSTALLATION

## 3-1. PACKING INFORMATION

3-2. The unit is packaged in a fiberboard carton and protected by foam pieces as shown in figure 3-1. The unit is first packed in a cardboard container and then this carton is packed in a second, larger cardboard container, for further protection. Save the packing container and materials for future use.

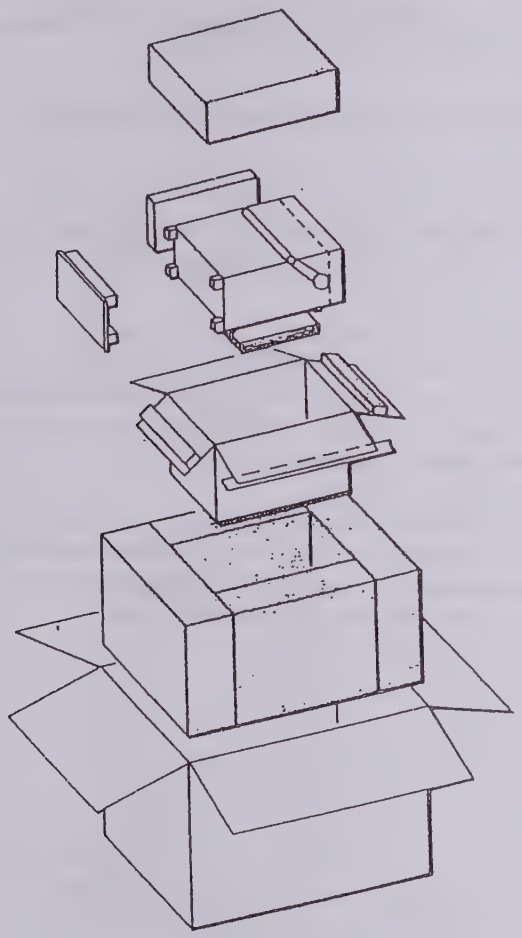


Figure 3-1. Typical Communication System Analyzer Packaging

3-3. All accessories supplied with the analyzer are packed in the analyzer cover.

## 3-4. INITIAL SETUP

**3-5. ANALYZER.** To set up the Analyzer for use, place the unit on workbench or in mobile repair unit. Remove the front cover by operating the two latches on the bottom of the cover. Lift the cover and slide it to the side to separate the hinges. Remove the power cord (AC or DC) that is stored in the cover. Attach the female connector of the power cord to the appropriate connector on the rear panel of the analyzer, and the other end to the power source. For AC power a grounded 3 wire power source of 100-130 Vac or 200-260 Vac, 47-63 Hz must be used.

NOTE

The unit is set for 110-130 Vac operation from the factory. For operation from 100-110 Vac or 200-260 Vac, the voltage selection card must be readjusted before connection to the power source. This is accomplished by the following procedure:

1. Remove the power cord from the rear panel connector.
2. Slide the selector card cover door over the connector area exposing the selection card and fuse area.
3. Pull outward on the fuse ejector tab and remove fuse.
4. Remove the printed circuit board voltage selector card by pulling straight to the rear.
5. Reinsert the card at the orientation which causes the appropriate voltage range (marked on card) to be displayed.
6. Install the proper fuse (1.5A for 100-130 VAC, 0.75A for 200-260 VAC).
7. Slide the cover plate back to the original position, connect power cord, and proceed with system operation.

Remove the accessories to be used from the cover. Move the POWER switch to the ON position. When the Oven Ready indicator illuminates the unit's frequency standard is stabilized and the unit is ready for use, (instantaneous with standard TCXO).

CAUTION

When installing the analyzer in a vehicle, the DC supply line should be fused close to the vehicle battery. The analyzer is protected against overload by the DC-8A fuse on the rear of the unit, but the vehicle is not protected.

**3-6. BATTERY PACK.** The battery pack is attached to the rear of the analyzer with two clips and two screws. Align and slide the mounting clips of the battery pack into the slots on the mounting brackets on the left side of the back panel of the analyzer. Align the captive screws with the mounting holes on the right of the panel and tighten. Connect the power plug to the connector at the top right of the rear panel.

# SECTION 4
# OPERATION

## 4-1. GENERAL

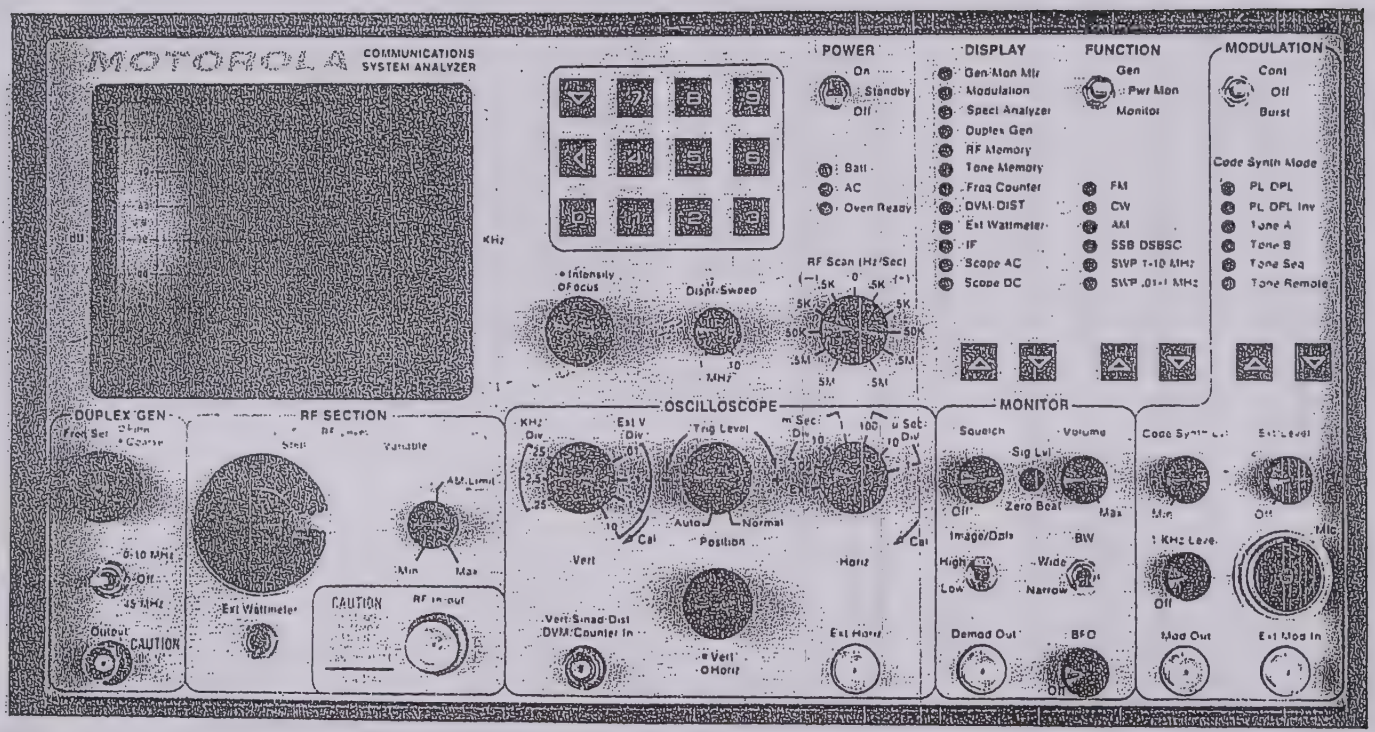
4-2. This section contains information for the operation of the Communication System Analyzer.

## 4-3. CONTROLS, INDICATORS, AND CONNECTORS

4-4. The analyzer controls, indicators, and connectors are shown in Figures 4-1 through 4-3 and listed with their functions in Table 4-1.

Table 4-1. Controls, Indicators, and Connectors

| Item | Description | Function |
|---|---|---|
| FRONT PANEL (fig. 4-1) | | |
| Keyboard | Twelve-key pushbutton keyboard | Enters variables into memory/enters manual variables/ selects variables to be used from the memory. |
| ▽ | Line cursor key | Moves the cursor down to the next line that may be changed. Preset permanent entries are skipped. Cursor will move down only. When on last line, will return to top line with next entry. |
| ◁ | Horizontal cursor key | Moves the horizontal cursor left to the next entry position that may be changed. When in the last left position, the cursor will move to the far right with the next entry. |
| 0 through 9 | Numerical keys | Used to select from the memory a stored value to be used, or to enter directly a value to be used. |
| • Intensity<br>• Focus | Stacked concentric potentiometers<br>• Intensity - center (small) knob | Controls the intensity of the scope presentation. |
| | • Focus - outside (large) knob | Controls the focus of the scope presentation. |
| Dispr/Sweep control | Potentiometer | Controls the frequency span (1-10 MHz) displayed on the CRT when unit is used as a spectrum analyzer. Provides sweep width control when either sweep function (SWP 0.01-1 MHz or SWP 1-10 MHz) is selected. |




82-2950

8486-11

Figure 4-1. Controls, Indicators, and Connectors, Front Panel

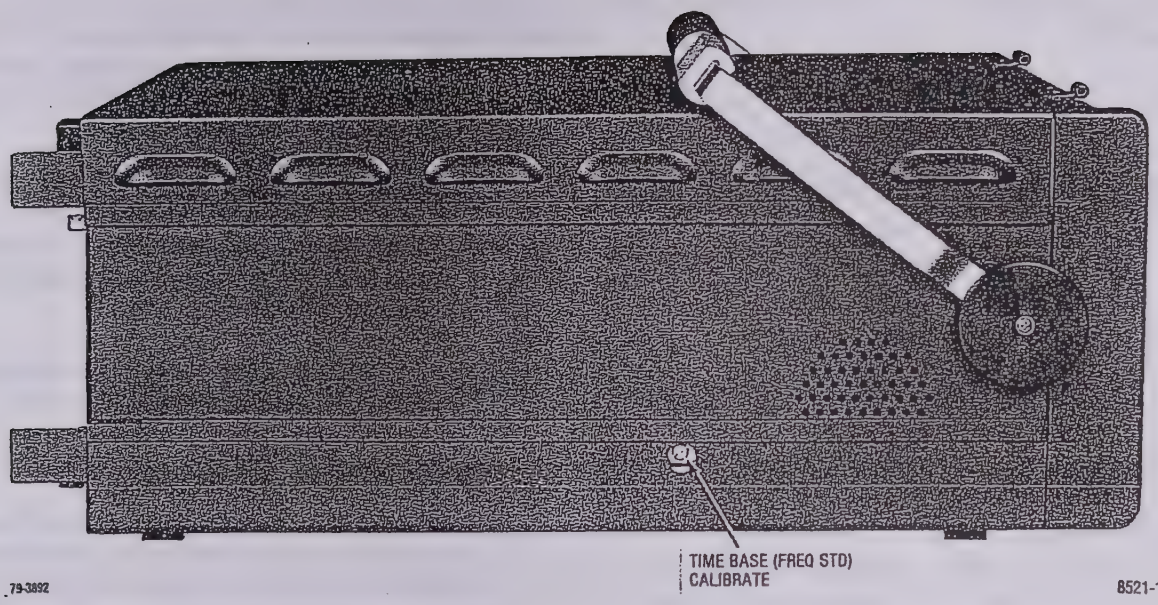



Figure 4-2. Controls, Indicators, and Connectors, Left Side Panel

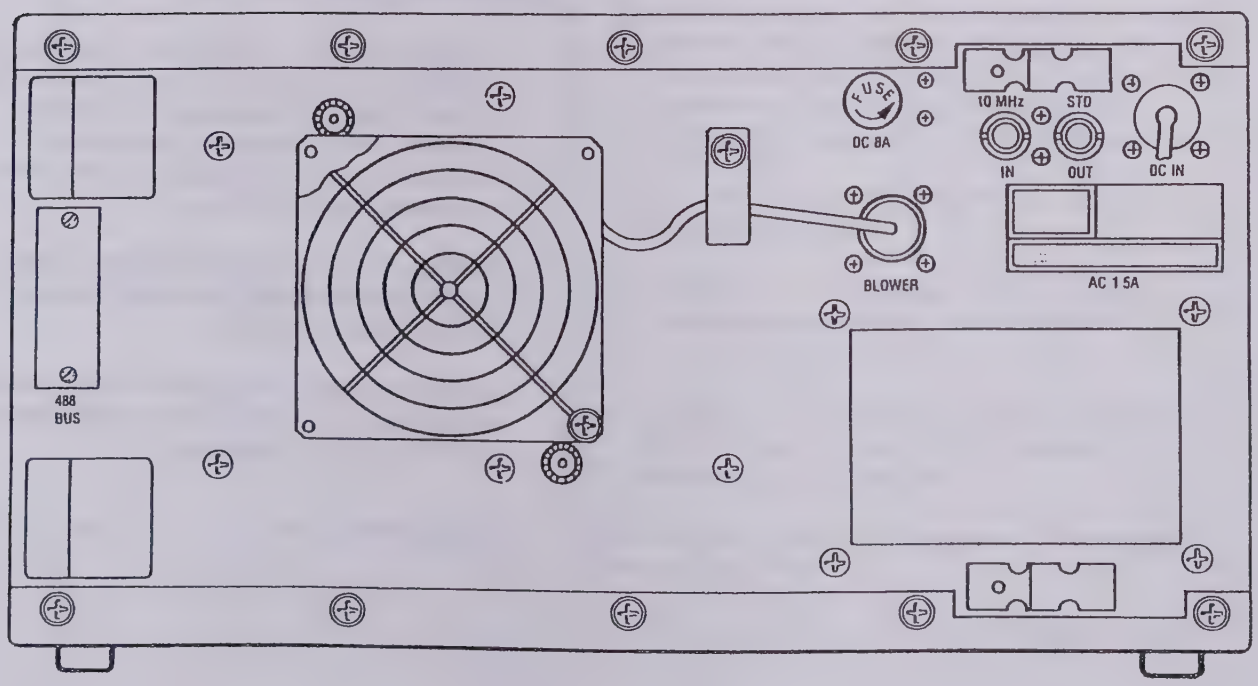



Figure 4-3. Controls, Indicators, and Connectors, Rear Panel

| Item | Description | Function |
|---|---|---|
| FRONT PANEL (fig. 4-1) | | |
| RF Scan (Hz/Sec) switch | Eleven position switch | Allows automatic scan of the generated or the monitored frequency. The switch setting indicates rate of frequency change. The rate is 5 steps per second, with frequency steps of 100 Hz, 1 kHz, 10 kHz, 100 kHz and 1 MHz. |
| POWER switch | Three-position toggle switch. | a. Energizes all circuitry in the On position.<br>b. At Standby position, removes DC from all circuitry except the frequency standard and battery charger.<br>c. At Off, only the battery charging circuitry is operative if an ac power source is being used. |
| Batt indicator | LED (red) | Illuminates when equipment is using DC power. |
| AC indicator | LED (red) | Illuminates when equipment is connected to an ac power source. Position of POWER switch has no effect on indicator. Equipment automatically switches to ac power source when connected to ac line voltage. |
| Oven Ready indicator | LED (red) | Illuminates when optional frequency standard oven has stabilized. Continuously illuminated with the TCXO frequency standard. |
| DISPLAY indicators | Twelve LEDs (red) | Illuminate one at a time to indicate the function or type of operation the equipment is performing and the information displayed on the CRT.<br>a. Gen/Mon Mtr — In the generate mode the center frequency, output power, and modulation depth of the RF output is displayed. In the monitor mode the center frequency, input power, frequency error, and modulation depth of the received carrier is displayed.<br>b. Modulation — The modulation audio in the generate mode or the demodulated audio in the monitor mode is displayed.<br>c. Spect Analyzer — The spectrum analyzer mode is enabled. The RF spectrum and the operating center frequency is displayed. |

Table 4-1. Controls, Indicators, and Connectors (Cont)

| Item | Description | Function |
|---|---|---|
| FRONT PANEL (fig. 4-1) | | |
| | | d. Duplex Gen — The duplex generate and monitor frequencies are displayed. The depth of modulation on the generator output or on the received carrier is indicated for the generate and monitor modes respectively. For this display, the function switch only selects which modulation reading is displayed.<br><br>e. RF Memory — The nine stored RF frequencies or DPL codes with their corresponding PL and the current frequency in use are displayed.<br><br>f. Tone Memory — The user selectable parameters for the code synthesizer are displayed.<br><br>g. Freq Counter — The frequency of the signal input to the front panel frequency counter jack is displayed.<br><br>h. DVM/Dist — The true RMS AC or DC level of the signal at the front panel DVM jack is displayed. The AC or DC mode is selected with the display cursor and the keyboard. The battery voltage is also displayed.<br><br>i. Ext Wattmeter — The external wattmeter element selected and the forward and reflected power being passed thru that element are displayed. The element select is changed by entering the appropriate range number with the keyboard.<br><br>j. IF — The 455 kHz IF signal from the monitor receiver is displayed.<br><br>k. Scope AC — The voltage waveform applied to the front panel vertical input is displayed. The vertical input is AC coupled.<br><br>l. Scope DC — The voltage waveform applied to the front panel vertical input is displayed. The vertical input is DC coupled. |
| FUNCTION switch | Three-position toggle switch | Controls the function of the equipment. The mode is shown by the LEDs.<br><br>a. Gen - equipment generates and outputs an RF signal. |

Table 4-1. Controls, Indicators, and Connectors (Cont)

| Item | Description | Function |
|---|---|---|
| FRONT PANEL (fig. 4-1) | | |
| | | b. Pwr Mon - equipment monitors input signals with the input terminated into the internal power meter. This position must be used for inputs of 0.2 watts and greater.<br><br>c. Monitor - equipment monitors input signals with the input terminated into the receive mixer. This position is used for "off the air" monitoring. |
| FUNCTION indicators | Six LEDs (red) | Indicates the mode or type of signal the equipment is set up to monitor or generate:<br><br>a. FM - equipment generates or monitors frequency modulated signals.<br><br>b. CW - equipment generates an unmodulated RF signal. Monitor CW provides frequency error measurement only.<br><br>c. AM - equipment generates or monitors amplitude modulated signals.<br><br>d. SSB/DSBSC - equipment generates a double sideband suppressed carrier signal.<br>NOTE: The level of the DSBSC signal generated is not calibrated, it is for use in relative measurements only. Monitor SSB mode receives SSB signals with the use of the BFO.<br><br>e. SWP 1-10 MHz - equipment generates a swept RF signal having a sweep width of 1 to 10 MHz, controlled by the Dispr/Sweep control. Selection of Monitor Sweep has no effect, equipment remains in generate mode.<br><br>f. SWP 0.01-1 MHz - equipment performs as in e. above except the sweep width limits are 0.01 MHz to 1 MHz. |
| MODULATION SWITCH | Three position toggle switch | Controls the Code Synthesizer modulation source. Code Synthesizer mode is shown by the LEDs.<br><br>a. Cont - Continuous modulation signal output.<br><br>b. Off - Turns off signal. When the mode is DPL or DPL Inv, returning the switch to Off from Cont produces a 133 Hz tone burst for a 120 ms duration. |

Table 4-1. Controls, Indicators, and Connectors (Cont)

| Item | Description | Function |
|---|---|---|
| FRONT PANEL (fig. 4-1) | | |
| | | c. Burst - For PL, tone A, and tone B modes the output is present for as long as the switch is held in the burst position. For the Tone Sequence mode the burst position causes a single signaling sequence to be output. For the DPL and DPL Inv modes the Burst position causes a 133 Hz tone to be output. For the Tone Remote mode either the Burst or the Cont position causes a tone remote access sequence to be output. The access sequence leaves tone A at a low level for transmit-type commands until the switch is returned to the Off position. This switch is spring loaded to return to the Off position from the Burst position. |
| CODE SYNTH Mode indicators | Six LEDs (red) | When illuminated, indicates the selected mode of the Code Synthesizer.<br><br>a. PL/DPL Indicator<br>PL - Selected Private Line frequency output to 1 kHz<br>DPL - Selected Digital Private Line code output Maximum code number is 777.<br><br>b. PL/DPL Inv indicator<br>PL - Same as above<br>DPL - Inverted output of selected Digital Private Line code. Maximum code number is 777.<br><br>The Private Line frequency or the Digital Private Line code is selected from the RF memory display or entered from the keyboard on the Gen Mon Mtr display.<br><br>c. Tone A indicator<br>Indicates Tone A selected for output<br><br>d. Tone B indicator<br>Indicates Tone B selected for output<br><br>e. Tone Sequence indicator<br>Indicates a tone signaling sequence will be output. The sequence is selectable on the Tone Memory Display. See Tone Memory Table examples, Figures 4-9, 4-10, 4-11 and 4-12.<br><br>f. Tone Remote indicator<br>Indicates access sequence for Motorola Repeater will be output. |

Table 4-1. Controls, Indicators, and Connectors (Cont)

| Item | Description | Function |
|---|---|---|
| FRONT PANEL (fig. 4-1) | | |
| | | Tone A and B frequencies are entered from the keyboard on the Tone Memory Display. |
| DISPLAY select switches | Two-pushbutton switches | Selects the function to be displayed by the equipment, as indicated by the DISPLAY LEDs.<br>a. △ - moves the selection up one step at a time<br>b. ▽ - moves the selection down one step at a time |
| FUNCTION select switches | Two-pushbutton switches | Selects the type or mode of signal the equipment will generate or monitor as indicated by the FUNCTION LEDs. Operation is the same as for the DISPLAY select switches. |
| Code Synth Mode select switches | Two-pushbutton switches | Selects the Code Synthesizer output mode as indicated by the CODE SYNTH MODE LEDs. Operation is the same as for the DISPLAY select switches. |
| Code Synth Lvl control | Potentiometer | Controls the level of Code Synthesizer for modulation or MOD Output. |
| Ext Level control | Potentiometer/switch | Controls modulation level of external input (microphone and other external generators). Switch at full counterclockwise position disables external modulation inputs. |
| Mic connector | 4-pin connector | Microphone input. Provides microphone bias and PUSH TO TALK (GENERATE) connection to equipment. |
| Ext Mod in connector | BNC connector | External modulation signal input. |
| 1 kHz Level control | Potentiometer/switch | Internal 1 kHz tone modulation level control. Switch at full counterclockwise position disables 1 kHz modulation tone. |
| Mod Out connector | BNC connector | Output connector for all modulation signals (all signals combined). |
| Volume control | Potentiometer | Controls speaker output level. |
| BW switch | Two-position switch | In either Pwr Mon or Monitor modes selects IF bandwidth. NB is ±6 kHz mod acceptance bandwidth. WB is ±100 kHz mod acceptance bandwidth. In Gen FM mode selects modulation range. 0-25 kHz dev in NB mode or 0-100 kHz dev in WB mode. |

Table 4-1. Controls, Indicators, and Connectors (Cont)

| Item | Description | Function |
|---|---|---|
| FRONT PANEL (fig. 4-1) | | |
| BFO control | Potentiometer/switch | BFO on/off and beat frequency control for sideband reception. Full Counterclockwise position is off. NOTE: To minimize interference the BFO should be turned off when not in use. |
| Sig Lvl/Zero Beat indicator | LED (red) | Flashes at a rate equal to the difference between the received carrier frequency and the programmed frequency. Also is used as a squelch indicator. |
| Squelch control | Potentiometer | Adjusts squelch threshold level, full counterclockwise position disables squelch. NOTE: Monitor sensitivity is greatly decreased (for high-level use) as the control is increased clockwise beyond the quieting point. |
| Image/Dplx switch | Two-position switch | In duplex generation mode, controls the duplex frequency output for above (High) or below (Low) the receive programmed frequency. In the monitor mode it selects the frequency of the local oscillator injection above or below the programmed monitor frequency to remove image interference. |
| Demod Out connector | BNC connector | Receiver audio output. |
| Oscilloscope Horiz switch | Seven-position rotary switch | When in the oscilloscope mode, selects the horizontal sweep rate or selects the external horizontal input. |
| Horiz Vernier control | Potentiometer | Horizontal sweep rate Vernier or external horizontal input gain Vernier. Calibrated position is fully clockwise. |
| Ext Horiz | BNC connector | Allows external horizontal inputs for oscilloscope. |
| Trig Level | Stacked concentric potentiometer and switch **See "CAUTION" note on page 4-19** | Selects oscilloscope trigger level and trigger mode. Center knob selects the level of trigger. Outside (largest) knob controls the trigger mode. In Auto position, continuous sweep with no vertical input signal, syncs on vertical input. Normal position, no sweep unless vertical input is present, syncs on vertical input. |
| Position controls | Stacked concentric controlled potentiometer | Controls the position of the CRT display, when in the oscilloscope mode. |
| • Vert | Center (small) control knob | Controls the vertical position of the CRT display |
| • Horiz | Outside (large) control knob | Controls the horizontal position of the CRT display |

Table 4-1. Controls, Indicators, and Connectors (Cont)

| Item | Description | Function |
|---|---|---|
| FRONT PANEL (fig. 4-1) | | |
| Vert switch | Four-position rotary switch | Oscilloscope operation uses values marked to the right of the switch, indicating volts per division on the CRT. Values marked to the left of the switch are used during modulation display mode, indicating range for calibrated FM deviation. NOTE: Frequency Counter sensitivity is also controlled by this switch. |
| Vert Vernier control | Potentiometer | Vernier gain control for vertical inputs to the CRT when in the oscilloscope mode. Fully clockwise is the calibrated position. |
| Vert/Sinad/DVM/Dist/ Counter In Connector | BNC connector | Signal input to the equipment for the following operations:<br>a. External vertical for oscilloscope operation<br>b. Distortion/SINAD Meter<br>c. Frequency Counter<br>d. Digital Voltmeter |
| RF in/out connector | Type N connector | RF input in the power monitor or monitor mode, RF output in the generate mode. |
| RF Level Variable control | Potentiometer | Vernier control of RF output level. Exceeding the AM limit marking in AM generation mode may result in a distorted output. |
| RF Level Step Switch | 14-position ganged atten and switch | Ten dB per step control of RF output level in generate mode. Also serves as RF input level step attenuator in monitor and spectrum analyzer modes. |
| Ext Wattmeter | Connector | Allows input from Motorola ST-1200 series inline wattmeter elements for measurement and CRT display of forward and reflected transmitted power. |
| Freq Set controls | Stacked concentric potentiometers | Controls the duplex generator output frequency in the Duplex Generation mode. |
| • Coarse | Inside (small) control knob | Coarse frequency control. |
| • Fine | Outside (large) control knob | Fine frequency control. |

Table 4-1. Controls, Indicators, and Connectors

| Item | Description | Function |
|---|---|---|
| FRONT PANEL (fig. 4-1) | | |
| Frequency offset control (0-10 MHz/Off/45 MHz) | Three-position switch | Selects the offset of the transmitted frequency from the selected receive frequency (Image/Dplx switch determines side of selected frequency the offset will be). 0-10 MHz position allows frequency offset to be varied between 0-10 MHz. In the 45 MHz position the offset is variable over a small range around 45 MHz with the use of the Fine frequency control. |
| Output connector | BNC connector | Output connector for duplex generator output. |
| SIDE PANEL (fig. 4-2) | | |
| Frequency Standard control | Potentiometer | Allows calibration of the time base frequency (freq std) |
| REAR PANEL (fig. 4-3) | | |
| DC 8A | Line fuseholder (8 amp) | DC input line fuseholder |
| DC IN power connector | 4-pin connector | Connects to DC prime power source |
| AC power connector | 3-pin connector | Connects to AC prime power source. Internally patched to accommodate either 100-110 VAC, 110-130 VAC, 200-220 VAC or 220-260 VAC. |
| AC 1.5A | Line fuseholder | AC line fuseholder. Use a 1.5A fuse when input voltage is between 100-130 VAC and a 0.75A fuse when input voltage is between 200-260 VAC. |
| 10 MHz std IN connector | BNC connector | Provides for external 10 MHz time base input. Equipment automatically switches to external time base with an input at this connector. |
| 10 MHz std OUT connector | BNC connector | Provides an output of the internal or external 10 MHz time base for external use. |
| 488 BUS connector | | Placement of I/O connector when IEEE-488 Interface Bus option is provided. |
| Blower power connector | 4-pin connector | Provides 110 VAC to the cooling fan. |

## 4-5. OPERATION

4-6. The operator may use the CRT display to become familiar with the functions the Communication System Analyzer is capable of performing. The unit may be preset to any of the functions the unit performs. As a function and i' parameters are selected they are displayed on the CRT.

The unit contains a nonvolatile memory that stores frequently used data for fast access, reducing setup time. As a function is selected, if data for that function is stored, the data is displayed on the CRT.

One of the stored parameters may be used or the user may manually select (keyboard entry) the parameters required for the function. Selection of stored data or keyboard entry of data is cursor controlled. As a control is changed the CRT display changes to reflect the new parameter being used for function being performed.

**4-7. CALIBRATE.** The Communication System Analyzer may be calibrated to WWV or other time/frequency standards (figure 4-4). To calibrate the unit's time base (frequency standard) proceed as follows:

a. Connect antenna to RF In/Out connector.

b. Set FUNCTION switch to Monitor and DISPLAY to Gen/Mon Mtr.

c. Enter frequency of time/frequency standards station directly from keyboard.

d. Select AM function.

e. Using a tuning tool, adjust time base frequency calibration control (on left side of housing) until CRT frequency error display indicates less than 5 Hz error. Frequency settability to 0.5 part per million can thus be achieved using a 10 MHz frequency standard station.

NOTE

The time base output is also available on the rear panel for external measurement or laboratory calibration to better than the 0.5 ppm achievable with the above method.

NOTE

An external time base input is also provided on the rear panel.

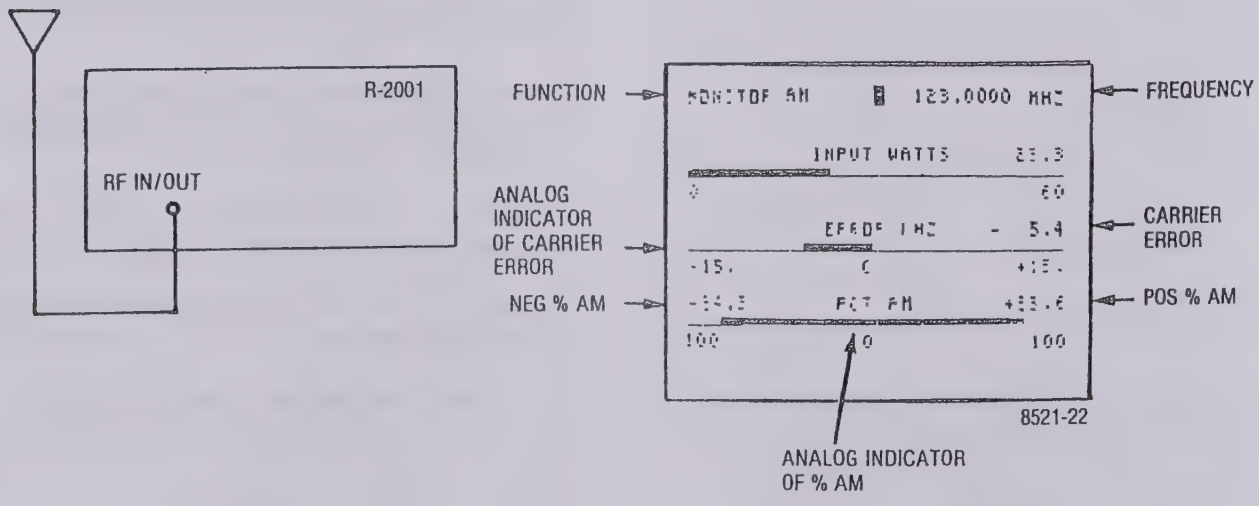



Figure 4-4. System Analyzer Time Base Calibrate Test Setup and CRT Display

**4-8. GENERATOR OPERATION.** The system generates RF frequencies for FM, AM, CW, SSB, and DSBSC types of transmission covering a range of 10 kHz to 1000 MHz. To generate a signal the FUNCTION switch is placed in the Gen. position.

NOTE

An RF protection circuit to protect against damage due to inadvertent application of RF power to the unit, when in a generate or sensitive monitor mode, is functional over the full monitor frequency range of the equipment (2 to 1000 MHz).

The type of signal is selected using the FUNCTION select LED indicator column. The unit can deliver an output of up to 1 volt into 50 Ohms. When in the AM generate mode the variable control (located in the RF SECTION on the front panel) should not be set above the AM limit mark. Exceeding this may cause distortion in the output.

NOTE

The RF protect circuit may trip if generator is run at full power output without having a 50-ohm load connected.

**4-9. DUPLEX GENERATION.** When operating in the duplex generate mode the offset frequency can be set to either 45 MHz or 0 to 10 MHz (adjustable). The Image/Dplx switch sets the offset frequency above (high) or below (low) the monitored frequency. When offset is in the 0 to 10 MHz range, the control range may include a foldback region. If the generator is operated in this foldback area erroneous frequency output indications can be given. Avoid areas where backward indication or a jittering display of the offset frequency are incurred. The following is an example of the duplex generator being used to setup repeater levels (Figure 4-5).

a. Connect DUPLEX GEN output to repeater receiver antenna input and repeater transmitter signal sample to RF In/Out connector. The Duplex Gen Output level is fixed at −30 dB nominal.

b. Set FUNCTION switch to Gen and DISPLAY to Duplex Gen.

c. Select Duplex Monitor frequency (repeater transmit frequency) from memory table or enter directly from keyboard.

d. Set DUPLEX GENERATOR frequency to repeater receiver frequency.

e. Adjust PL and test tone deviation to desired level on display.

f. Set FUNCTION switch to Monitor and measure the deviation of the repeated signal.

NOTE

Switch function to power monitor and connect repeater transmitter (under 125 watts) directly to the RF In/Out connector to read power and frequency error, as well.

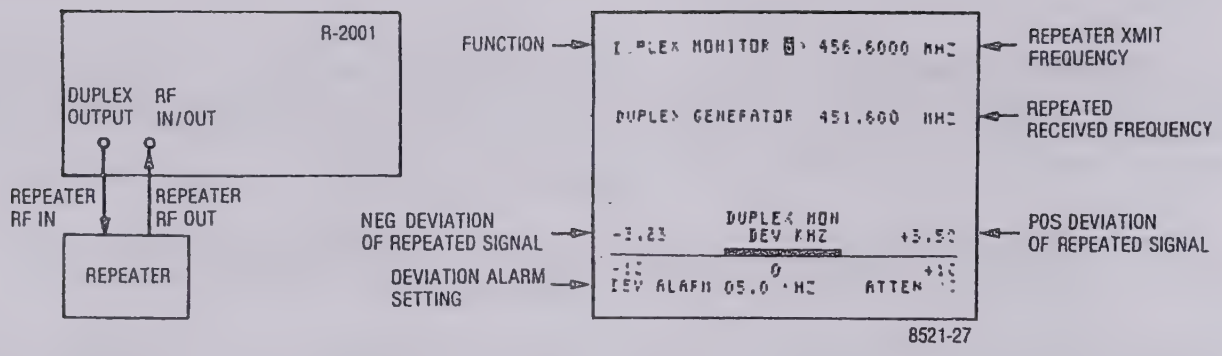



Figure 4-5. Duplex Generation Test Setup and CRT Display

**4-10. FREQUENCY COUNTER.** The frequency counter measures inputs in a range from 10 Hz to 35 MHz. The input to the frequency counter is through the Vert/Sinad/Dist/DVM/Counter in, BNC connector (located in the OSCILLOSCOPE section of the front panel). The counter sensitivity is controlled by the scope Vert switch. The following shows the minimum sensitivity for each switch setting.

| Switch setting | Sensitivity |
|---|---|
| 0.01 | 50 mV RMS |
| 0.1 | 500 mV RMS |
| 1.0 | 5V RMS |
| 10.0 | 50V RMS |

The autorange output of the counter is displayed on the CRT to a resolution of 0.1 Hz or 5 digits.

NOTE

Do not connect transmitter directly to the frequency counter input. Instead use the RF In/Out connector and the frequency error meter for transmitter frequency measurements.

**4-11. SPECTRUM ANALYZER.** Input to the spectrum analyzer is through the RF In/Out connector. Select the spectrum analyzer position on the DISPLAY column. Place the FUNCTION switch in the monitor position. Select the desired width of sweep by the Dispr/Sweep control. The center frequency is selected from the memory or entered directly from the keyboard, it is displayed at the top-right of the CRT. The following is an example of locating the frequency of an incoming signal with the spectrum analyzer (Figure 4-6).

a. Connect antenna to RF IN/OUT connector.

b. Set FUNCTION switch to Mon. and DISPLAY to Spect. Analyzer.

c. Select center frequency from memory table or enter directly from keyboard.

d. Adjust Disp/Sweep control for desired spectrum span.

e. Adjust Step attenuator if required to reduce sensitivity.

f. To determine whether a given displayed signal is valid or being internally generated, flip the Image/Dplx switch to the opposite position. If signal moves in frequency or disappears, it then/represents an internally generated spurious response or received image.

g. Use the RF Scan control to move desired signal to center of the screen. If the signal is located to the right of screen center line, move the RF Scan control clockwise into one of five positive stepping modes. If the signal is to the left of screen center line, turn the RF Scan control counter clockwise to one of five negative stepping modes.

h. Adjust Dispr/sweep control fully counterclockwise for 1 MHz spectrum span.

i. Again use RF Scan to recenter signal on screen.

j. Set DISPLAY to Gen/Mon Mtr.

k. Now adjust the RF scan control to minimize any existing frequency error between the incoming signal and the Monitor frequency.

l. The frequency indicated at the top of the screen is now that of the desired incoming signal. It can also be monitored for call signs, etc.

**NOTE**

The spectrum analyzer is functional but uncalibrated for level measurements in Power Monitor mode for transmitter testing with the built-in 125 watt 50 ohm load. (Observe "RF LOAD OVERTEMP" warning for high power levels or extended periods of use.)

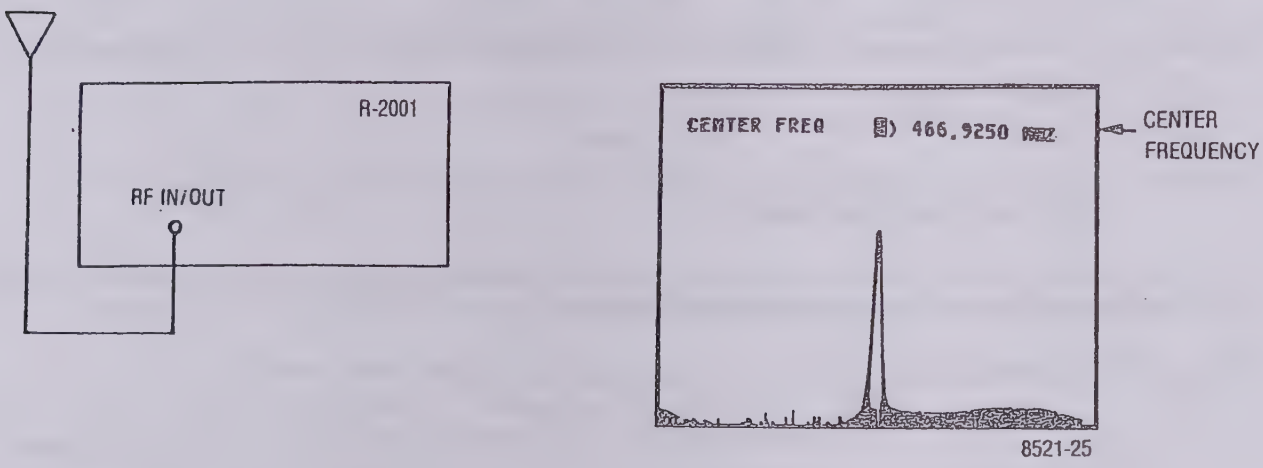



Figure 4-6. Spectrum Test Setup and CRT Display

**4-12. MONITOR.** The analyzer is capable of monitoring the same frequencies that it generates (para 4-9). Select Gen/Mon Mtr in the DISPLAY column and the modulation type in the FUNCTION column. Set the FUNCTION switch to the Monitor position for small signal samples or off the air monitoring. For high power signal monitoring (0.2w to 125w), set the FUNCTION switch to Pwr Mon.

**CAUTION**

To prevent undue stress on the protected circuits it is advisable to always switch the system to the power monitor mode before applying power in excess of 200 mw. Additional protection is also obtained by making it a practice not to leave the step attenuator in the 0 dB position.

NOTE

High-powered equipment in the 1-30 MHz range, which has unusually fast carrier rise times, may damage the system analyzer with repeated activation of the protect circuit. Ensure the FUNCTION switch is in the Pwr Mon position (this enables the protect circuit) before RF power is applied to the equipment.

In the monitor mode the CRT displays the type of signal being monitored, the selected frequency, power, error of the received frequency, and the modulation level.

**4-13. EXT WATTMETER.** When the analyzer DISPLAY is set to the Ext Wattmeter mode and the Motorola RTL-4055B in-line wattmeter adapter (supplied) is connected to the Ext Wattmeter jack the analyzer measures both forward and reflected power. The power rating of the wattmeter elements (Motorola ST-1200 series*), to be used, are displayed on the CRT. The following is an example of a test setup for external wattmeter operation. Figure 4-7 shows the test set connections and CRT display.

a. Select the EXT Wattmeter function by means of the arrow keys located below the DISPLAY column.

b. Plug the connector of the RTL-4055B In-Line Wattmeter adapter into the "Ext-Wattmeter" jack located on the RF SECTION of the front panel.

c. Using the keyboard; enter the single digit which corresponds to the full scale power rating of the ST-1200 series element you plan to use.

d. Place the ST-1200 element in the In-Line Wattmeter adapter and install element/adapter assembly into transmission line.

NOTE

Arrow on In-Line Wattmeter Adapter must point in the forward direction of the desired rf power flow through the adapter.

e. Key transmitter and observe magnitudes of forward and reflected power as displayed simultaneously on the 2 analog meter bars and corresponding digital readouts.

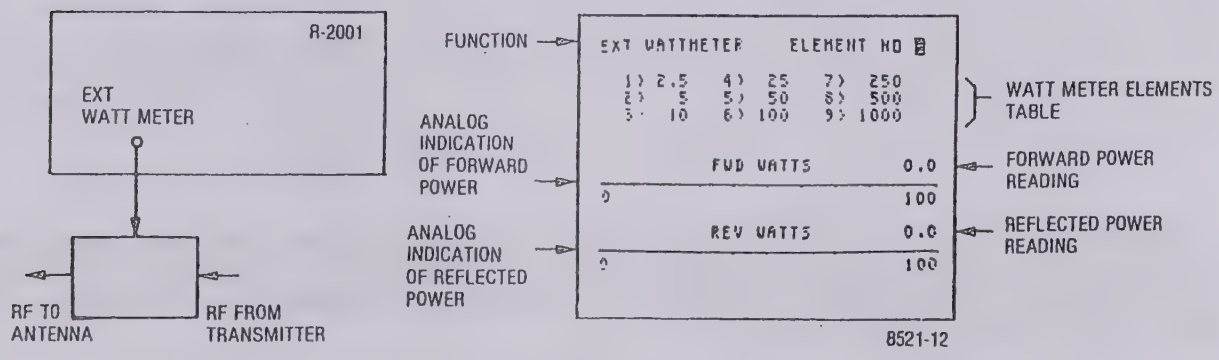



Figure 4-7. Wattmeter Test Setup and CRT Display

*Contact your Motorola Parts Source for ordering separately.

**4-14. SIMULTANEOUS GENERATE AND MEASUREMENT OPERATIONS.** The following test setups and CRT displays are examples of simultaneous generating and measurement operations.

a. FM Mobile radio setup for receiver sensitivity using Generator and SINAD meter (Figure 4-8).

1. Connect RF In/Out mobile radio antenna connector and multipurpose measurement (SINAD) input to receiver audio output.

2. Set FUNCTION switch to Gen. and DISPLAY switch to Gen/Mon Mtr.

3. Select frequency from RF memory table or enter directly from keyboard.

4. Adjust 1 kHz level for 3.0 kHz deviation and RF level for 12 dB SINAD indication. (The mobile radio audio output may be set to the desired level using the DVM AC mode.)

5. Read receiver SINAD sensitivity in microvolts or dBm.

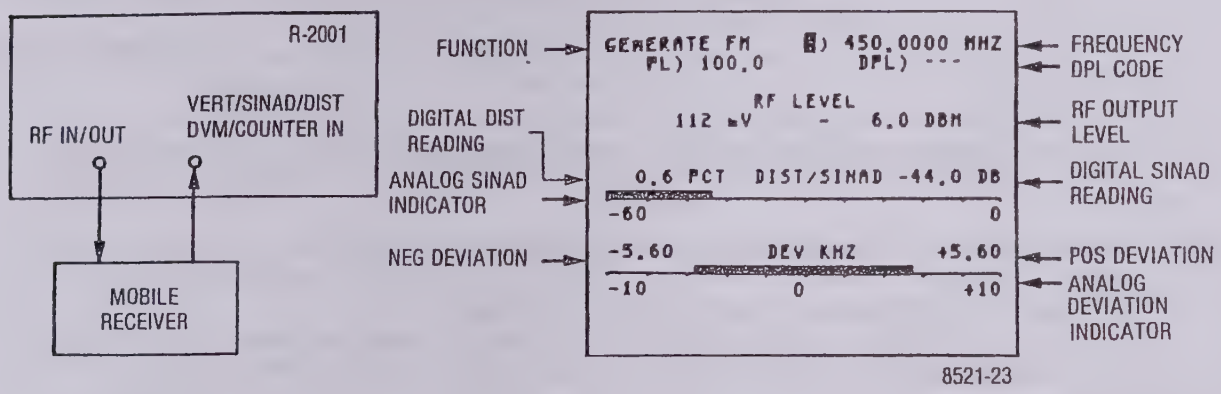



Figure 4-8. Test Setup for FM Receiver Sensitivity Using Generator and SINAD Meter with CRT Display

b. Test two-tone pager decode and alert function, and demonstrate simultaneous modulation (Figure 4-9).

1. Set FUNCTION switch to Gen and DISPLAY to Gen/Mon Mtr.

2. Select pager frequency from RF memory table or enter directly from keyboard.

3. Set the DISPLAY to Tone Memory and enter the A/B mode number in the mode select position from the keyboard. For an A/B sequence the mode number is 1. The stored information for the A/B sequence is then automatically displayed on the lower part of the display.

4. Enter the number of the desired two-tone sequence in the sequence select position from the keyboard.

NOTE

Timing sequences 1 and 2 are preset and cannot be changed. Sequences 3 and 4 are keyboard programmable for testing other pager types, upper and lower timing limits, or future schemes.

5. Enter the pager code Tone A and Tone B Frequencies from the keyboard.

6. Set the DISPLAY to Gen/Mon Mtr, the code synthesizer mode to tone A or tone B, and the MODULATION switch to Cont.

7. Adjust the Code Synth Lvl control for the desired level of modulation.

8. Set the Code Synth Mode to Signal Sequence and the MODULATION switch as desired to activate the pager under test.

9. The scope trigger delay setting at the bottom of the Tone Memory Display can be entered as necessary to delay the triggering of the oscilloscope horizontal sweep from the start of the tone sequence. This feature aids in troubleshooting tone decoders with the system oscilloscope.

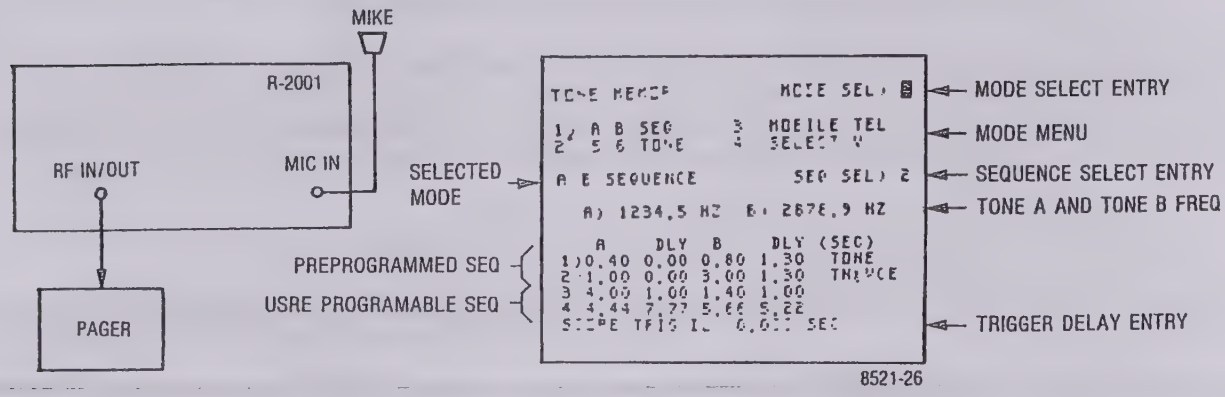



Figure 4-9. Test Setup for Two-Tone Pager and Alert Functions with CRT Display

c. Test 5/6 Tone Pager decode and alert function (Figure 4-10).

1. Set FUNCTION switch to Gen and DISPLAY to Gen/Mon Mtr.

2. Select pager frequency from RF memory table or enter directly from the keyboard.

3. Set the DISPLAY to Tone Memory and enter the 5/6 tone mode number in the mode select position from the keyboard. For a 5/6 tone sequence the mode number is 2. The stored information for the 5/6 tone sequence is then automatically displayed on the lower part of the display.

4. Select either a 5-tone or a 6-tone sequence by entering a 1 or 2 in the sequence select position from the keyboard.

5. Enter the desired CAP code from the keyboard.

6. Set the DISPLAY to Gen/Mon Mtr, the Code Synth Mode to Tone Seq, and the MODULATION switch to Cont.

7. Adjust the Code Synth Lvl control for the desired level of modulation.

8. Connect the pager as shown in Figure 4-10 and set the MODULATION switch as desired to activate the pager under test.

9. Enter the scope trigger delay setting at the bottom of the Tone Memory Display as necessary to delay the triggering of the horizontal sweep relative to the start of the tone sequence when troubleshooting the tone decoder with the oscilloscope.

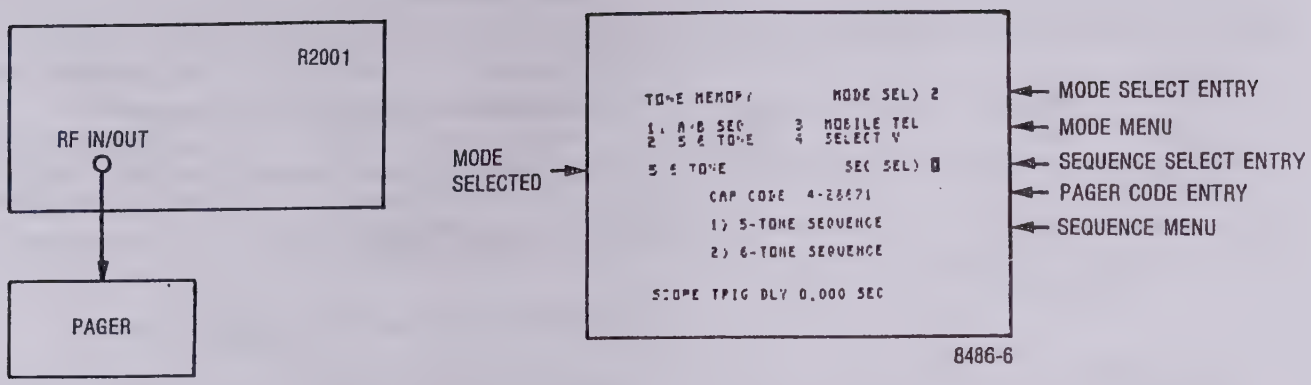



Figure 4-10. Test Setup for 5/6 Tone Pager with CRT Display

d. Test Mobile Telephone Receiver and Supervisory Decoder (Figure 4-11).

1. Set the FUNCTION switch to Gen and the DISPLAY to Tone Memory.

2. Select the Mobile Telephone mode by entering the number 3 in the mode select position from the keyboard. The stored information for the mobile telephone sequences will be automatically displayed on the lower part of the screen.

3. Select the desired mobile telephone sequence by entering the appropriate number in the sequence select position from the keyboard: 1-IMTS, 2-MTS, 3-2805.

4. With the keyboard enter the appropriate Tone 1 and Tone 2 frequencies on the display.

5. Enter the desired telephone number from the keyboard into the Telephone Number position onthe display.

6. Set the DISPLAY to Duplex Gen and set the DUPLEX GEN switch to the 0-10 MHz or 45 MHz position as applicable. Enter the desired receive frequency from the keyboard and then set the desired transmit frequency using the DUPLEX GEN frequency controls.

7. Set the MODULATION switch to the Cont position and adjust the Code Synth Lvl control for the desired level of modulation.

8. Set the FUNCTION to Pwr Mon and the DISPLAY to Gen/Mon Mtr.

9. Connect the system to be tested as shown in figure 4-11 and set the MODULATION switch as required to test the mobile telephone receiver and supervisory decoder.

10. Enter the scope trigger delay setting shown at the bottom of the Tone Memory display as necessary to aid in troubleshooting the decoder circuits.

**CAUTION: The entry of a scope trigger delay will prevent normal operation of scope triggering as long as the unit is in the position "MODULATION", "Tone Seq."**

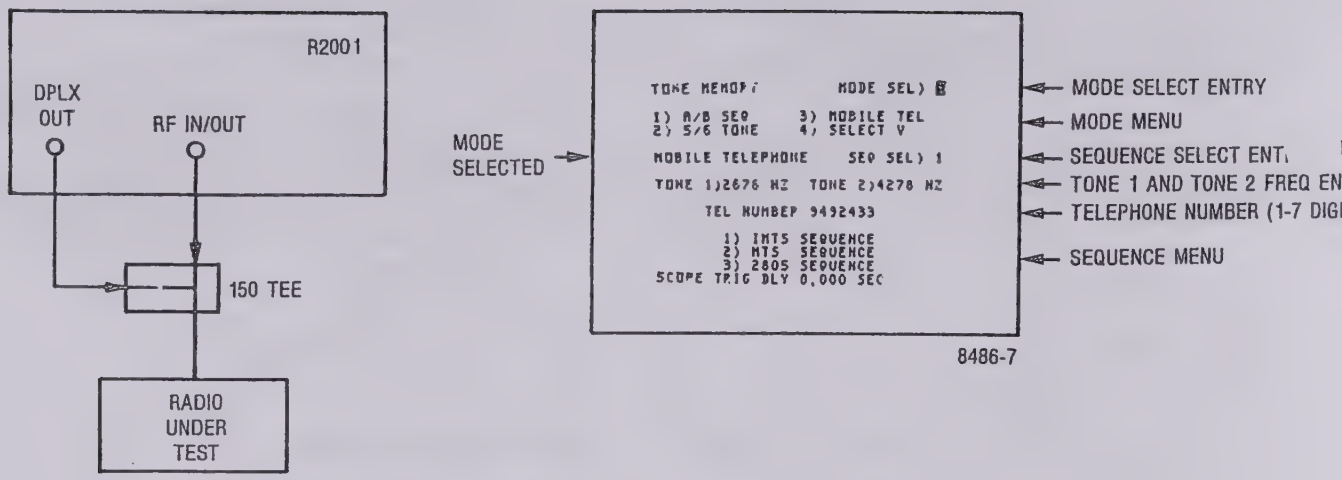



Figure 4-11. Test Setup for Mobile Telephone Test with CRT Display

e. Test Select V decode function (Figure 4-12).

1. Set the FUNCTION switch to Gen and the DISPLAY switch to Tone Memory.

2. Select the Select V mode by entering the number 4 in the mode select position from the keyboard. The stored information for the mobile telephone sequence will be automatically displayed on the lower part of the display.

3. Enter the number of the desired Select V sequence in the sequence select position on the display from the keyboard.

4. Enter the desired access number from the keyboard into the access code position on the display.

5. Set the DISPLAY to Gen/Mon Mtr., the Code Synth Mode to Tone Seq, and the MODULATION switch to Cont.

6. Adjust the Code Synth Lvl control for the desired level of modulation.

7. Connect the system to be tested as shown in figure 4-12 and set the MODULATION switch as desired to test the Select V decoder.

8. Enter the scope trigger delay setting shown at the bottom of the Tone Memory display as necessary to aid in troubleshooting the decoder circuits.

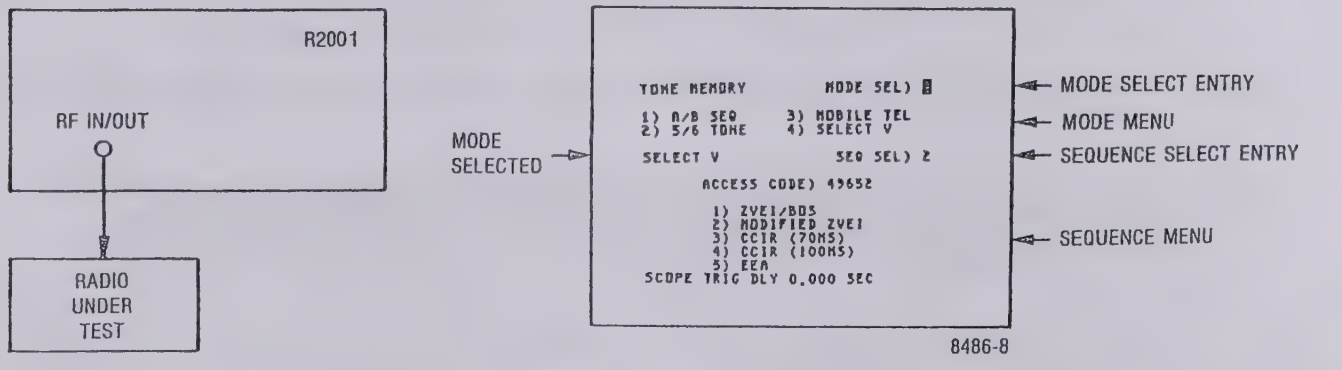



Figure 4-12. Test Setup for Select V Test with CRT Display

f. Troubleshooting Receiver audio stages using "DVM and Signal Generate" function simultaneously (Figure 4-13).

1. Select the DVM function by means of the arrow keys located below the DISPLAY column.

2. Using the keyboard "down" arrow position the CRT cursor adjacent to the "DVM Mode" graphics.

3. Enter a "1" via the keyboard to select AC voltage measurement or a "2" for DC voltage measurement selection.

4. Set up the desired on-channel RF signal to provide an input to the receiver.

5. Set FUNCTION switch to "Gen". Set appropriate RF output level (as indicated on the CRT screen).

6. Apply test signals from the receiver audio stages to the instrument's "Vert/Sinad/Dist/DVM/Counter In" input. DC Voltage measurement points are also applied to this same input. The supplied X1 test probe may be used.

7. Refer to the CRT screen for an auto-ranging and analog/digital indication of either DC voltage or AC voltage and corresponding dBm level.

NOTE

The AC DVM indication of dBm is referred to 600 ohms.

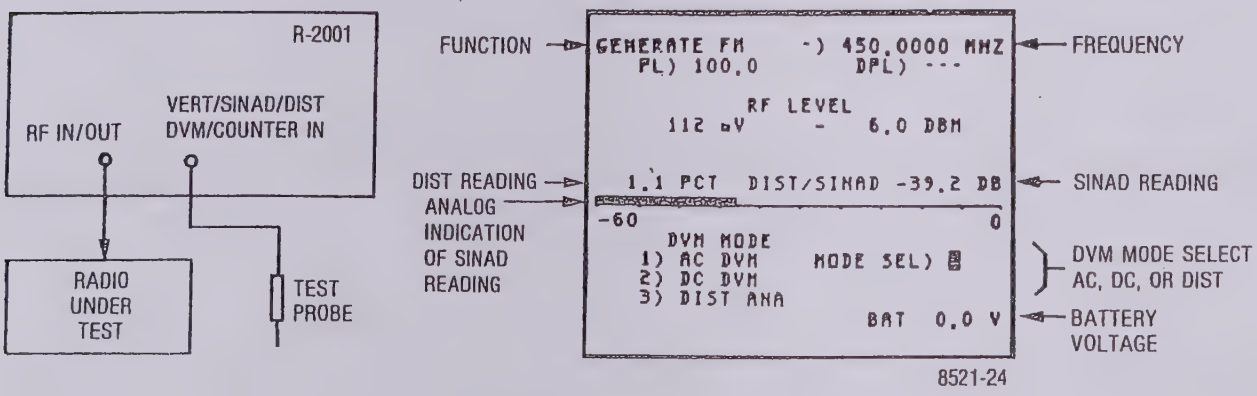



Figure 4-13. Test Setup for Using DVM and Signal Generate with CRT Display

MOTOROLA, INC.
COMMUNICATIONS SECTOR
TEST EQUIPMENT REPAIR CENTER
1313 EAST ALGONQUIN ROAD SCHAUMBURG, ILLINOIS 60196

# TEST EQUIPMENT REPAIR REQUEST FORM

This completed form must accompany equipment returned for repair.

| CUSTOMER'S PURCHASE ORDER NO. | | DATE | |
|---|---|---|---|
| MODEL NUMBER | | SERIAL NUMBER | |
| DESCRIPTION OF PROBLEM: | | | |
| REQUESTED REPAIRS: | | | |
| SHIP TO ADDRESS: | | | |
| SHIP VIA: | | | |

Providing the information below will reduce the turnaround time on your Test Equipment Repair.

| MOTOROLA CUSTOMER NUMBER | BILL TAG | SHIP TAG | INTERNAL MOTOROLA ACCOUNT NO. |
|---|---|---|---|
| | | | |

SIGNED: _____

# SECTION V
# MAINTENANCE

## 5-1. SERVICE

5-2. The Motorola Test Equipment Repair Center is charged with the service responsibility for all test equipment supplied by the Motorola Communications Group. The center maintains a stock of original equipment replacement parts and a complete library of service information for all Motorola test equipment.

5-3. Most in-warranty repairs are performed at the center. Exceptions include repairs on some equipment not manufactured by Motorola which are performed by the original supplier under the direction of the Test Equipment Repair Center. Out-of-warranty service is performed on a time and materials basis at competitive rates and the maximum turn-around goal is less than ten working days. Customer satisfaction is continually surveyed by reply cards returned with repaired instruments.

5-4. The Test Equipment Repair Center also provides a convenient telephone troubleshooting service. Frequently, a user technician can troubleshoot a piece of equipment and isolate defective components under the direction of the Test Equipment Repair Center via telephone. Required replacement parts are then immediately shipped to the user thereby reducing shipping time and servicing costs. For telephone troubleshooting contact the Test Equipment Repair Center toll free at (800) 323-6967.

5-5. All other inquiries and requests for test equipment calibration and repairs should be directed to the Area Parts Office. They will contact the Test Equipment Repair Center, process the necessary paperwork and, if necessary, have the Center contact you to expedite the repair.

## 5-6. REPLACEMENT PARTS ORDERING

5-7. Motorola maintains a number of parts offices strategically located throughout the United States. These facilities are staffed to process parts orders, identify part numbers, and otherwise assist in the maintenance and repair of Motorola Communications products.

5-8. Orders for all replacement parts should be sent to the nearest area parts and service center listed below. When ordering replacement parts the complete identification number located on the equipment should be included.

## 5-9. ADDRESSES

### 5-10. General Offices

MOTOROLA INC.
Communications Division Parts Dept.
1313 E. Algonquin Rd.,
Schaumburg, Illinois 60196
Phone: 312-397-1000
Executive Offices: 1301 E. Algonquin Rd.,
Schaumburg, Illinois 60196

### 5-11. U.S. Orders

**WESTERN AREA PARTS**
1170 Chess Drive, Foster City,
San Mateo, California 94404
Phone: 415-349-3111
TWX: 910-375-3877

**MID-ATLANTIC AREA PARTS**
7230 Parkway Drive
Hanover, Maryland 21076
Phone: 301-796-8600
TWX: 710-862-1941

**EASTERN AREA PARTS**
85 Harristown Road
Glen Rock, New Jersey 07452
Phone: 201-447-4000
TWX: 710-988-5602

**SOUTHWESTERN AREA PARTS**
3320 Belt Line Road
Dallas, Texas 75234
Phone: 214-241-2151
TWX: 910-860-5505

**GULF STATES AREA PARTS**
8550 Katy Freeway
Houston, Texas 77024
Phone: 713-932-8955

**MIDWEST AREA PARTS**
1313 E. Algonquin Rd.
Schaumburg, Ill. 60196
Phone: 312-576-7322
TWX: 910-693-0869

**EAST CENTRAL AREA PARTS**
12995 Snow Road
Parma, Ohio 44130
Phone: 216-267-2210
TWX: 810-421-8845

**PACIFIC SOUTHWESTERN AREA PARTS**
9980 Carroll Canyon Road
San Diego, California 92131
Phone: 714-578-2222
TWX: 910-335-1634

**SOUTHEASTERN AREA PARTS**
5096 Panola
Industrial Blvd.,
Decatur, Georgia 30032
Phone: 504-981-9800
TWX: 810-766-0876

### 5-12. Canadian Orders

**CANADIAN MOTOROLA ELECTRONICS COMPANY**
Parts Department
3125 Steeles Avenue
East Willowdale, Ontario
Phone: 516-499-1441
TWX: 610-492-2713
Telex: 02-29944LD

### 5-13. All Countries Execpt U.S. and Canada

**MOTOROLA INC., OR MOTOROLA AMERICAS, INC.**
International Parts
1313 E. Algonquin Road,
Schaumburg, Illinois 60196 U.S.A.
Phone: 312-397-1000
TWX: 910-693-1592 or 1599
Telex: 722433 or 722424
Cable: MOTOL

**CAUTION**

This equipment contains parts that are subject to damage by static electricity. Proper precautions should be taken during handling.

**WARNING**

Lithium Battery

The processor module within this system utilizes a lithium battery as a memory keep-alive voltage source. Do not mutilate or disassemble the battery cell. The lithium metal is a very active material that burns in the presence of water or high humidity. Do not put the battery in fire, attempt to charge, heat above 100°C, or solder directly to the cell. Do not overdischarge the cell to a reverse voltage greater than 3 volts. The battery may burst and burn or release hazardous materials. See paragraph 5-143 of this manual for battery troubleshooting procedures and cautions.

**CAUTION**

Lithium Battery

Lithium batteries are classified as hazardous materials and must be disposed of accordingly. Do not dispose of the battery by placing it in with the everyday trash. Consult state and local codes for the appropriate disposal procedure. Motorola will dispose of the battery if the expended battery is returned in the replacement battery container and by the same method that the new battery came to you to: Motorola Inc., Return Goods Department, 1313 East Algonquin Road, Schaumburg, Ill. 60196.

## 5-14. MAJOR ASSEMBLIES

5-15. The Communication System Analyzer is designed for ease of maintenance. Most of the circuitry is on twelve plug-in circuit boards. A list of all subassemblies is given in table 5-1. The assembly locations are shown in figures 5-1 and 5-2.

Table 5-1. List of Subassemblies

| Ref. Des. | Item | Part Number As Labeled | Replacement Order Part No. |
|---|---|---|---|
| A1 | Low Voltage Power Supply Module | 01-P07897V001 | RTP-1005A |
| A1A1 | Low Voltage Power Supply Switcher Module | 01-P07891V001 | RTP-4016A |
| A1A2 | Low Voltage Power Supply Output Module | 01-P07856V001 | RTP-4013A |
| A1A3 | Low Voltage Power Supply Control Module | 01-P07853V001 | RTP-4012A |
| A1A4 | Lower Voltage Power Supply Relay Module | 01-P07892V001 | 01-80305A68 |
| A2 | Scope Amplifier Module | 01-P00413N002 | RTC-4007B |
| A3 | Scope/DVM Control Module | 01-P24154A001 | RTC-4024A |
| A4 | Receiver Module | 01-P00389N002 | RTL-1002B |
| A5 | Synthesizer Module | 01-P00385N002 | RTC-1001B |
| A5A* | Digital Synthesizer Card | 01-P00358N002 | RTC-4009B |
| A5B* | RF Synthesizer Card | 01-P00386N002 | RTC-4010B |
| A6 | Audio Synthesizer Module | 01-P00426N002 | RTC-4011B |

Table 5-1. List of Subassemblies (Cont)

| Ref. Des. | Item | Part Number As Labeled | Replacement Order Part No. |
|---|---|---|---|
| A7 | Processor Input/Output Module | 01-P24158A001 | RTC-4025A |
| A8 | IEEE Bus Module (Optional) | 01-P00203N002 | RTC-4013B |
| A9 | Microprocessor/Character Generator Module | 01-P24162A001 | RTC-4026A |
| A10 | High Voltage Power Supply Module | 01-P07896V001 | RTP-1006A |
| A11 | RF Input Module | 01-P00394N003 | RTC-1002B |
| A11A1* | Protection/Power Meter Card | 01-P00400N002 | RTL-4061B |
| A11A2* | Converter/Wide Band Amplifier Card | 01-P00398N002 | RTC-4015B |
| A11A3* | Offset Generator Card | 01-P00399N002 | RTC-4016B |
| A12 | Front Panel Interface Module | 01-P07846V001 | RTL-4086A |
| A13 | Frequency Standard Module | 01-P07898V001 | RTL-1011A |
| A14 | Front Panel Assembly | 01-P07860V001 | 01-80305A64 |
| A14A1 | Display Board Assembly | 01-P07843V001 | 1-80305A63 |
| | Motherboard Assembly | 01-P07894V001 | RTL-4089A |

*These items are solder-in submodules listed for reference purposes. These cards are not normally repaired or replaced individually.

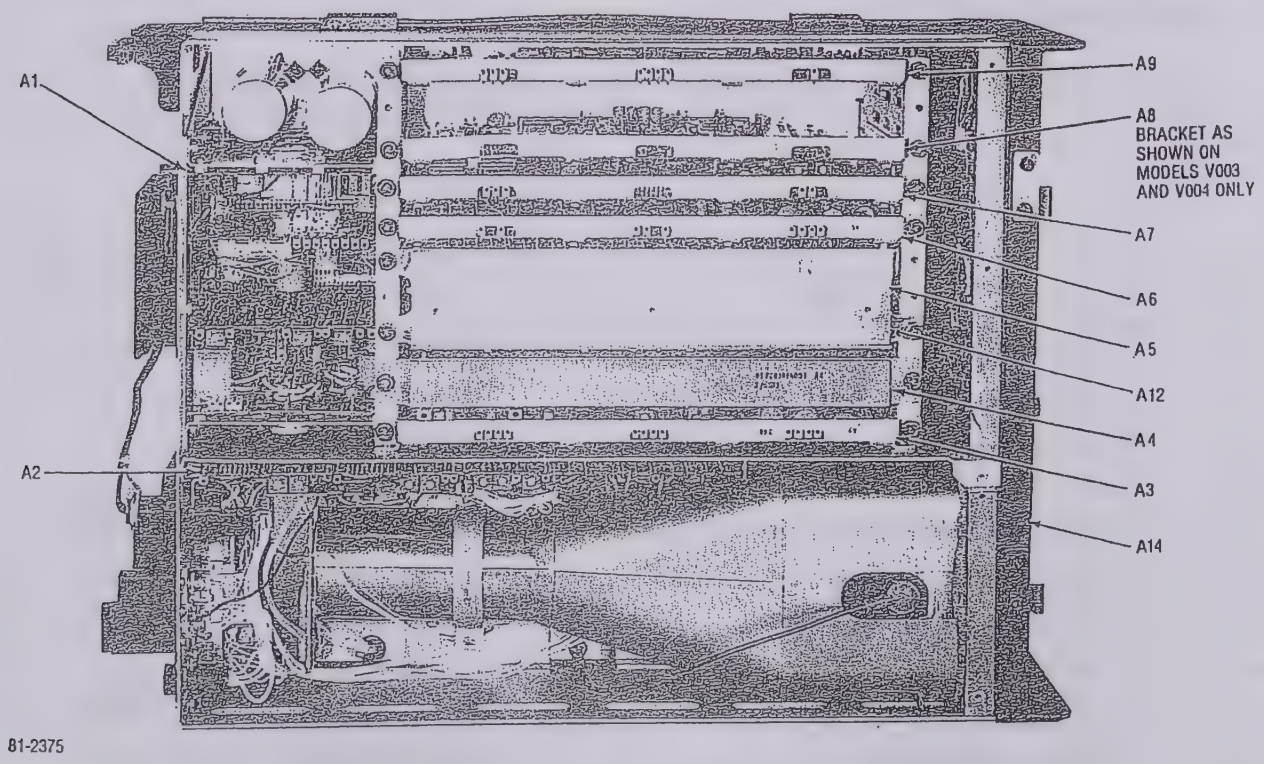



Figure 5-1. Communications System Analyzer, Top View, Cover Removed

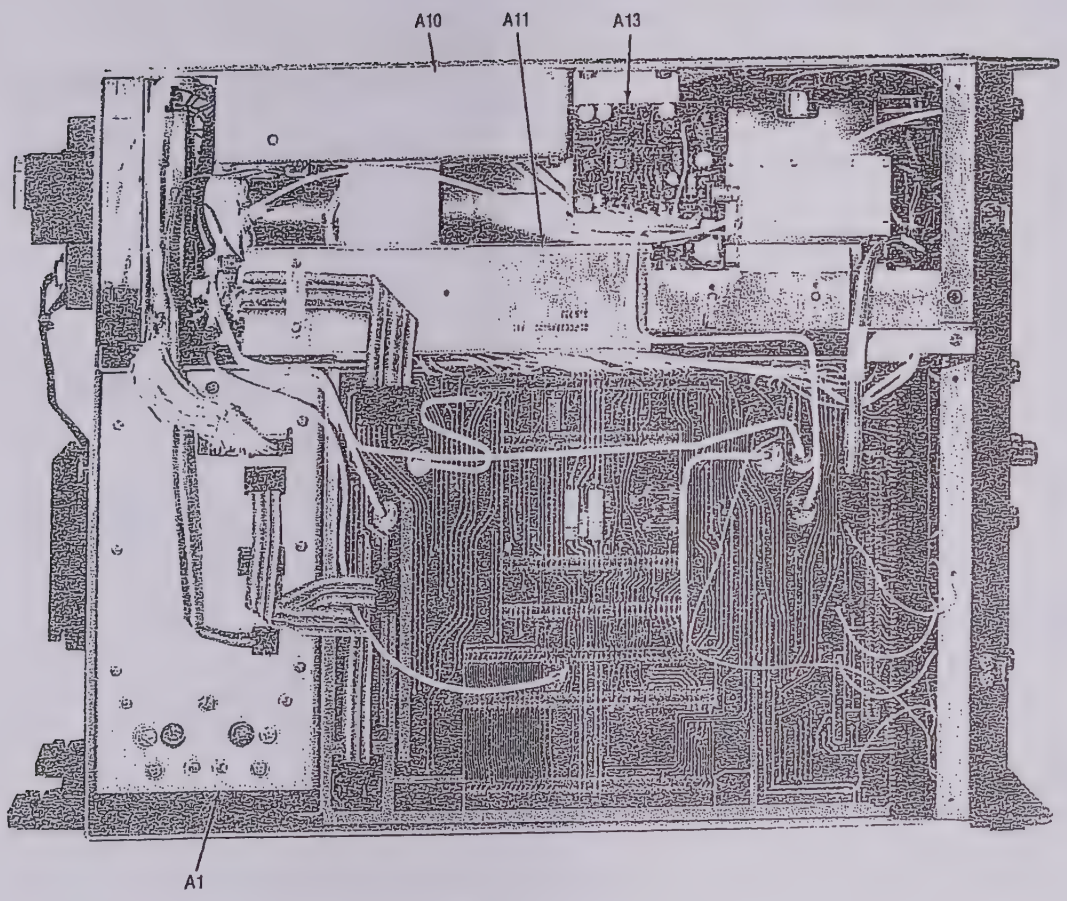



Figure 5-2. Communications System Analyzer, Bottom View, Cover Removed

## 5-16. THEORY OF OPERATION

### 5-17. General

5-18. The operation of the Communications System Analyzer can be divided into nine basic functions; Generate, Power Meter, Monitor, Duplex Generator, Code Synthesizer, Frequency Counter, Digital Voltmeter (DVM), Oscilloscope, and Distortion/SINAD Meter. The general operation of the unit will simultaneously incorporate the basic functions to provide the total capability of the system.

5-19. The following discussion will cover the block diagrams for each of the basic functions plus a discussion on the processor control of the system. A functional block diagram of the total system is shown in figure 5-3. Only the major signal paths between each of the modules are shown to clarify the total system configuration.

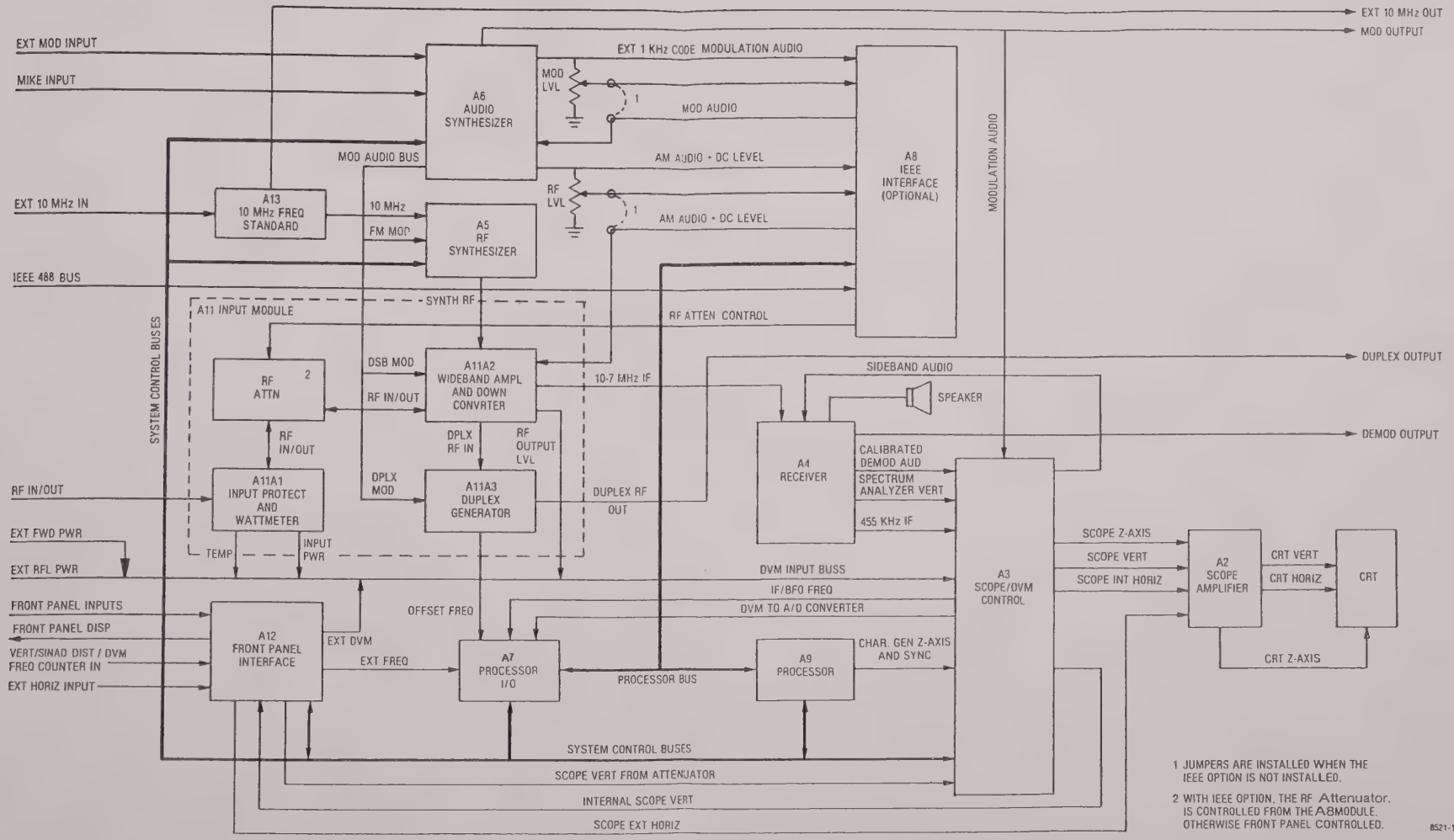



Figure 5-3. Communication System Analyzer, Block Diagram

### 5-20. System Control

5-21. System Control is the primary responsibility of the internal microprocessor. Front panel control and system status inputs to the processor are manipulated by the processor to provide the control for the operating mode. From the front panel the processor monitors the keyboards, the function select switch, the modulation control switch, the RF scan switch, the image switch, the bandwidth switch, the horizontal and vertical range switches, and the step attenuator switch. This information plus internal status information causes the processor to display the appropriate information on the CRT to program the center frequency, to set up the generate or monitor mode, and to make the internal switching arrangements for the selected operating state.

5-22. The interface to and from the microprocessor is via the processor bus. This bus consists of a 16-bit address bus, an 8-bit data bus, and a 7-bit control bus. This bus interfaces the processor to its program memory (ROM), scratch pad memory (RAM), IEEE interface, and the peripheral interface adapters (PIA). The PIA is the mechanism by which the processor interfaces with the system. A PIA consists of a dual 8-bit latch which may be programmed as either an input or output for the microprocessor. System input and control information passes to and from the microprocessor via three system control buses attached to a PIA.

5-23. Each system control bus consists of a 4 bit address bus, a 4 bit data bus, and an enable line. The 4 address bits determine which of 16 possible latches the 4 bits of data is to be sent to or received from. The enable line triggers the actual transfer of data. The three control buses within the system are called the RF control bus and the AF control buses 1 and 2. The RF control bus is as described above while the AF control buses consist of a single 4-bit address and 4-bit data bus and two enable lines. The resulting total input/output capability for the system buses is 16 latches at 4-bits each times 3 buses or 192 bits. A tabulation of buses and the controlling or input function of each bit is shown in table 5-2.

5-24. Systems with the IEEE remote control option interface the IEEE bus to the processor bus through a general purpose interface bus adapter (GPIB) on the IEEE interface module. When enabled all control inputs to the system pass through the IEEE bus and front panel controls are ignored. For more information on IEEE control see section 21.

### 5-25. Generate Mode

5-26. The generate mode provides a variable level RF output that is phase locked to the internal 10 MHz standard. AM, FM, and Sideband Modulation are possible on the output signal. A block diagram of the generate mode is shown in figure 5-4.

5-27. The Frequency Standard module (A13) contains a 10 MHz standard oscillator with buffering and switching to provide a 10 MHz signal to the EXTERNAL 10 MHz OUTPUT and to the RF Synthesizer (A5). A provision is made for the application of an EXTERNAL 10 MHz INPUT which causes the internal standard to shut down and the EXTERNAL 10 MHz INPUT to be switched to the EXTERNAL 10 MHz OUT and to the RF Synthesizer.

5-28. The 10 MHz standard input to the RF synthesizer is digitally divided down to provide SYSTEM REFF FREQUENCIES for the frequency counter, the zero beat detector, the second local oscillator in the receiver, and the processor timing reference. Additionally reference frequencies are provided for a fixed 550 MHz locked loop and for a programmable 500 MHz-1000 MHz locked loop. The programming of the 500 MHz-1000 MHz locked loop is provided by the RF CONTROL BUS from the processor. The SELECT SWITCH selects one of three possible output points for the SYNTH RF output signal. The first is from the 500 MHz-1000 MHz loop directly. The second is from a divide by two on the output of the 500 MHz-1000 MHz loop which gives frequencies from 250 MHz to 500 MHz. For outputs below 250 MHz, the output of the 500 MHz- 1000 MHz loop is mixed with the fixed 550 MHz signal and the difference signal used for the output. For this output the processor programs the 500 MHz - 1000 MHz loop for frequencies between 550.01 MHz and 800 MHz to obtain outputs from 10 kHz to 250 MHz respectively.

5-29. FM and SWEEP Modulation is implemented within the 500 MHz-1000 MHz loop. FM capability is 200 kHz peak which when divided by two gives the 100 kHz peak requirement. Similarly the sweep capability is 10 MHz peak which provides the 5 MHz requirement for the sweep generator and spectrum analyzer requirements.

Table 5-2. Control Buses and Functions

| Data / ADRS | RF Bus D3 | RF Bus D2 | RF Bus D1 | RF Bus D0 | AF Bus #1 D3 | AF Bus #1 D2 | AF Bus #1 D1 | AF Bus #1 D0 | AF Bus #2 D3 | AF Bus #2 D2 | AF Bus #2 D1 | AF Bus #2 D0 | Data / ADRS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 310-440 PLL A0 | | | | Audio Synth N0 | | | | Display Led's | | | | 0 |
| 1 | 310-440 PLL N0 | | | | Audio Synth N1 | | | | Function Led's | | | | 1 |
| 2 | 310-440 PLL N1 | | | | Audio Synth N2 | | | | Mode Led's | | | | 2 |
| 3 | 60 PLL N0 | | | | Audio Synth N3 | | | | Input Scope Atten | | | | 3 |
| | | | | | | | | | 0.001 | 0.01 | 0.1 | 1.0 | |
| 4 | 60 PLL N1 | | | | PL Sel | DPL CLK Enab | DPL Sel | AUDIO Synth N4 | | | Atten Int/Ext Sel | Ext In AC/DC Sel | 4 |
| 5 | 60 PLL N2 | | | | MOD To Spkr Enab | Audio Atten 30 dB | Aduio Atten 20 dB | Audio Atten 10 dB | RF Atten Position | | | | 5 |
| 6 | 60 PLL N3 | | | | DPLX MOD Enab | DSBSC MOD Enab | FM MOD Enab | AM MOD Enab | Scan Switch Position | | | | 6 |
| 7 | 310-440 PLL A1 | | 60 PLL N4 | | | | | | IF Overl'd In | SIG Present In | RF Input <+20 dB In | WB/NB Sw In | 7 |
| 8 | | | 500-1000 Out Enab | 250-500 Out Enab | DVM MODE Select | | | | $\overline{\text{CSSG}}$ $\overline{\text{Cont}}$ Sw In | $\overline{\text{CSSG}}$ $\overline{\text{Burst}}$ Sw In | Hi/Lo Image Sw In | Gen Sw In | 8 |
| 9 | WB MOD Enab | (MOD) x (2) Enab | MOD $\overline{\text{INV}}$/INV Sel | MOD FM/SWP Sel | Scope Trig Enable | Pk Det FM MOD Enab | Pk Det AM MOD Enab | Pk Det Demod Enab | Scope Vertical Switch Pos In | | | | 9 |
| | | | | | | | | | $\overline{\text{10 V/ DIV}}$ | $\overline{\text{1V-100kHz DIV}}$ | $\overline{\text{0.1V-10kHz DIV}}$ | $\overline{\text{0.01V-1kHz DIV}}$ | |
| A | 0.01-1000 Sel | 500-700/ 700-1000 VCO Sel | LOOP INV/$\overline{\text{INV}}$ Sel | MOD Disable | Distor Notch Filter X1 X10 Gain | Int DVM x 0.1 Enab | WB/NB Sel | IF/BFO Freq Sel | $\overline{\text{Mon}}$ Sw In | Scope Horiz Switch Pos Sw In | | | A |
| B | | | | | Horiz Scope Mode Sel | | Vert Scope Mode Sel | | | | | | B |
| C | | | | | Pwr MTR Enab | (Mon + DSB)/ Gen Sel | Ext/Distor- tion Select | .01-1 /1-10 Swp Sel | | | | | C |
| D | SSB Demod Enab | FM Demod Enab | AM Demod Enab | Demod To Spkr Enab | Scope Time Base CTL | | | | | | | | D |
| | | | | | SSC3 | SSC2 | SSC1 | SSC0 | | | | | |
| E | WB/NB Sel | Demod INV/$\overline{\text{INV}}$ Sel | Alarm Enab | LIN IF/ Log IF Sel | Scope Time Base CTL | | | | DVM RMS/DIR Sel | Freq Cntr Range | | | E |
| | | | | | SSC7 | SSC6 | SSC5 | SSC4 | | | | | |
| F | | | | | | | | | Ctr/DVM Sel | Counter Input Sel | | | F |
| | | | | | | | | | | IF/BFO | Offset | Ext | |

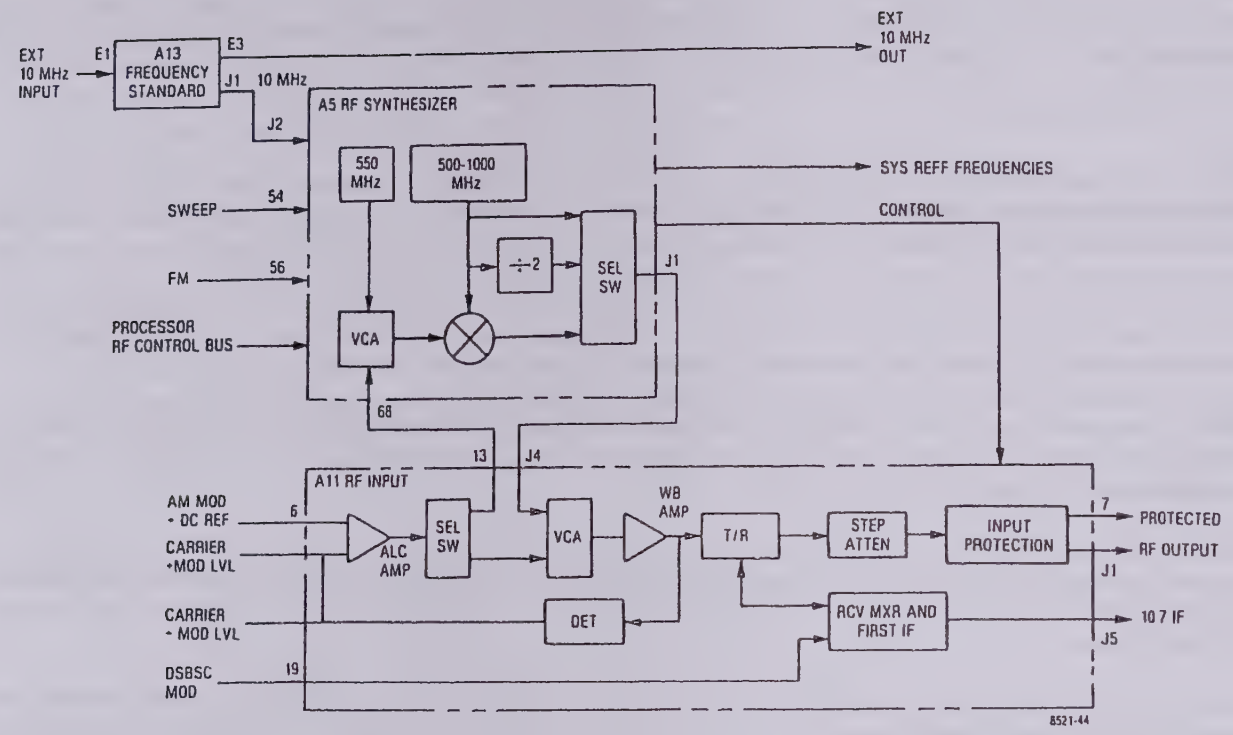



Figure 5-4. Generate Mode Block Diagram

5-30. The SYNTH RF signal is amplified and leveled in the RF input module (A11). The signal level at the output of the wideband amp is detected and compared to the AM MOD & DC REF signal from the front panel level control. If there is a difference between the two signal levels, the ALC amp provides an error voltage. The error voltage controls the attenuation of the Voltage Controlled Attenuator (VCA) in the direction that will make the detected RF output equal to the AM MOD & DC REF signal. There are two possible VCA's for the output leveling. The VCA within A11 is used for frequencies from 1 MHz to 1000 MHz. For frequencies below 1 MHz, the VCA on A11 is set to minimum attenuation and the VCA on the RF Synthesizer module is used for leveling. Amplitude modulation is incorporated by summing the modulation signal with the DC reference signal to force the leveling loop to vary the output level in proportion to the modulating signal. The signal from the RF level detector (CARRIER + MOD LVL) is used by the processor for the determination of RF output level and the percent AM. The leveled output range of the Wideband Amp is from −3 dBm to +13 dBm (0.16 to 1.0 Vrms).

5-31. The leveled output from the Wideband Amplifier is applied to the Generate/Monitor (T/R) switch. For AM, FM, and CW signals the switch connects the amplifier output to the Step Attenuator. For Double Sideband Suppressed Carrier (DSBSC) the T/R switch is in the "R" position where the amplifier output is connected to the local oscillator port on the receive mixer and the attenuator is connected to the RF port. The DSBSC MOD signal is then used to drive the IF port of the mixer giving a DSBSC signal at the RF port and thus at the Step Attenuator.

5-32. Coarse level control in 10 dB increments is provided by the Step Attenuator. The total range of the attenuator is from 0 dB to 130 dB attenuation. For the basic R2001C the Step Attenuator is controlled directly by a shaft to the front panel knob. With the IEEE control option the Step Attenuator is electrically programmable and controlled by the processor. The front panel knob in this case is connected only to a rotary switch which directs the processor in setting the attenuation level. Under IEEE control, commands via the IEEE bus determine the attenuator setting. (See section 21.)

5-33. The RF signal from the Step Attenuator passes through the input protection circuitry to the RF Output jack. A level detector on the RF Output jack monitors the power level at the jack. If power in excess of 200 mW is applied to the Output jack, the protection circuit will activate and switch the RF Output jack to the internal 50 ohm load. This

action protects the Wideband Amp and Step Attenuator against burnout. A signal line from the protection network signals the processor that the system is in the protected mode. The processor in turn activates the CRT and alarm warnings.

### 5-34. Power Meter

5-35. Input power measurements are made with the RF input terminated into an internal 50 ohm load. This termination is the same one used for the protect mode when in the generate or monitor functions. A block diagram of the power meter is shown in figure 5-5.

5-36. For the power meter mode the processor sets the WATT METER ENABLE line to cause the RF input jack to be switched to the 50 ohm power termination. For modes other than the power meter, an input Detector on the RF input jack detects when the input power has exceeded 200 mW and then switches the input to the load.

5-37. The switch is a single pole double throw configuration so that when switched to the RF load the path to the Step Attenuator and Converter is open circuited. However, leakage across the open switch provides sufficient signal for operation of the normal monitor functions.

5-38. A sample of the RF voltage being applied to the RF Load is detected by the Power Detector to give a DC output proportional to the peak RF voltage. The amplifier following the detector buffers and gain adjusts the detected voltage to provide the RF INPUT POWER signal to the processor. The processor then determines and displays the RF input power.

5-39. A Temperature Sensor located near the flange of the RF Load alerts the processor when the load temperature exceeds 80°C. The processor reacts to the OVER TEMPERATURE signal by displaying a warning message on the CRT and by sounding the audible alarm.

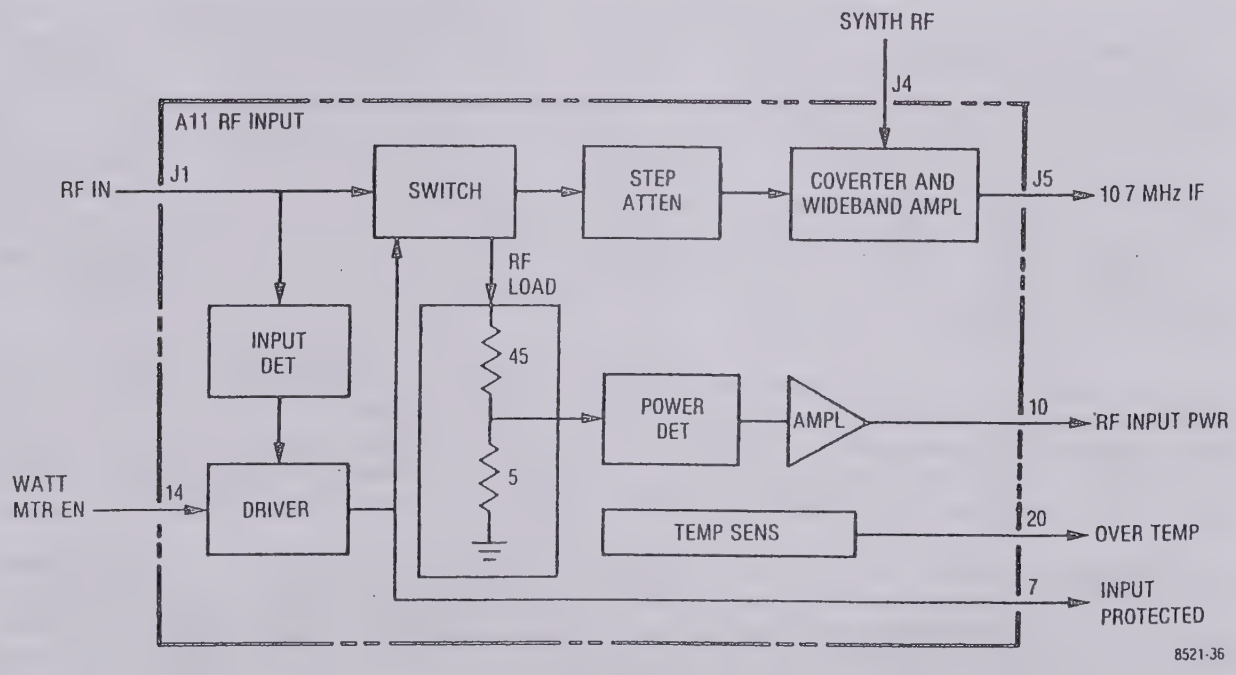



Figure 5-5. Power Meter Block Diagram

## 5-40. Monitor Mode

5-41. The monitor mode allows RF signals from an antenna or from a transmitter directly to be checked for frequency error, modulation level, and spectral content. AM, FM, and sideband modulations can be accommodated with this system. A block diagram of the monitor mode is shown in figure 5-6.

5-42. The RF signal to be monitored is applied to the RF Input jack on the RF Input module (A11). If the input level is less than 200 mW the input signal passes directly through the Input Protection circuitry to the Step Attenuator. For input levels greater than 200 mW the protection circuit switches the input to the internal load and signal the operator to switch to the Power Monitor mode. In this case, RF leakage (paragraph 5-37) through the protection circuits provides the input signal to the Step Attenuator.

5-43. For the monitor mode the T/R switch is set so that the RF input from the Step Attenuator is connected to the RF port on the receive mixer. The output from the wideband amp is switched to the local oscillator port on the receive mixer. The processor programs the RF Synthesizer for an output frequency that is offset from the frequency to be monitored by 10.7 MHz. The offset may be above or below the center frequency as selected by the front panel image switch.

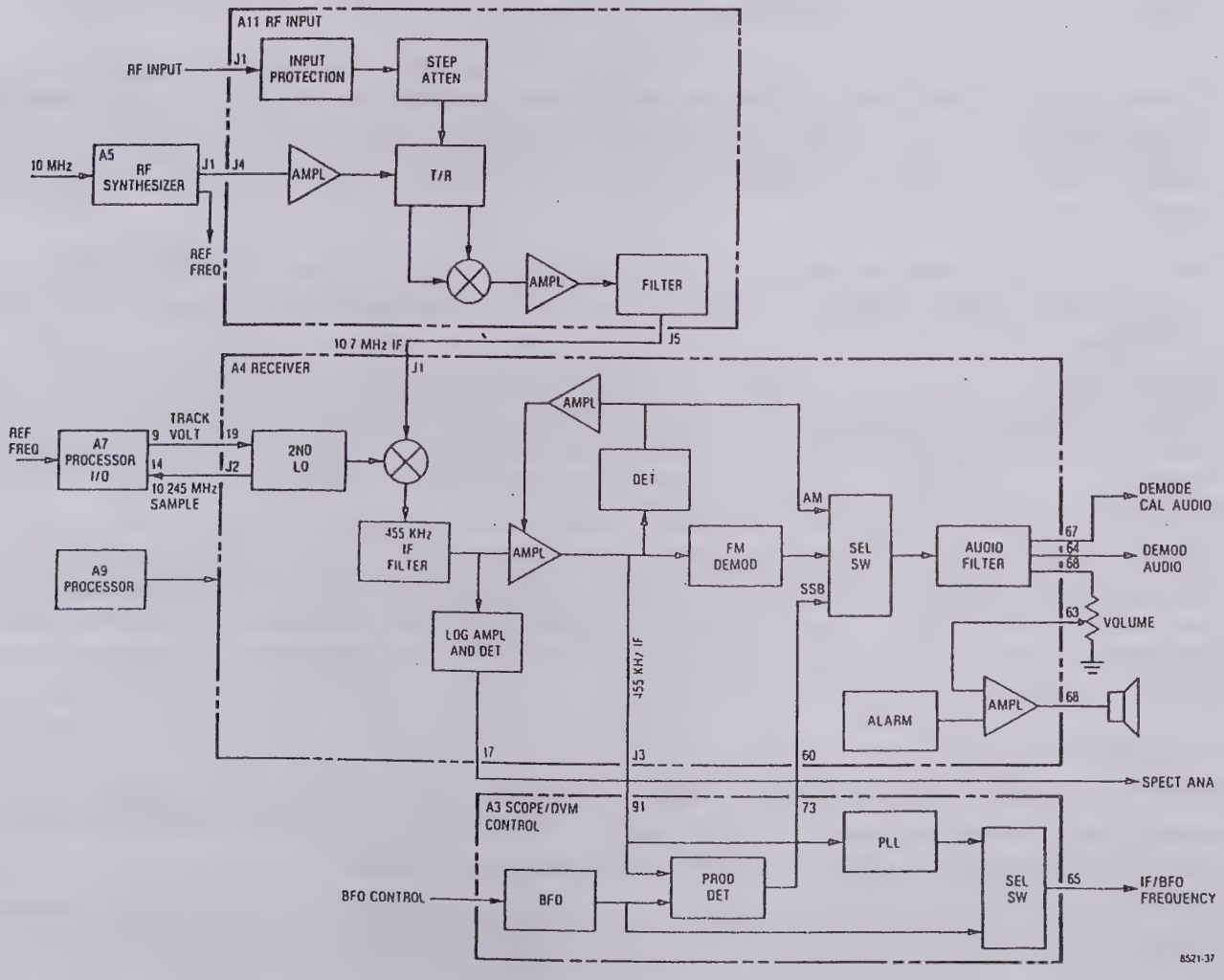



Figure 5-6. Monitor Mode Block Diagram

5-44. The 10.7 MHz difference signal at the IF port of the receive mixer is amplified and selected by the first IF Amplifier and Filter. The Amplifier provides sufficient gain so that the overall gain of the RF Input module is 10 ±2 dB. The IF filter provides a modulation acceptance bandwidth of ±100 kHz. The filter output is the 10.7 MHz IF signal to the Receiver module (A4).

5-45. A second mixer in the receiver module down converts the 10.7 MHz IFsignal to 455 kHz by mixing the input signal with a 10.245 MHz Second Local Oscillator. The Second Local Oscillator is phase locked to the 10 MHz system standard so that its frequency is as accurate as the standard. The phase locked loop for the Second Local Oscillator is split between two modules. A 10.245 MHz SAMPLE signal is compared with the REFERENCE FREQUENCIES from the RF Synthesizer on the Processor I/O module (A7). The comparison provides a TRACKING VOLTAGE error signal to the 10.245 MHz oscillator which corrects its frequency to hold it in lock.

5-46. Immediately following the second mixer is the IF filter. The IF filter is selectable between a narrowband (±6 kHz mod acceptance) and a wideband (±100 kHz mod acceptance) bandwidth. The bandwidth is under the control of the processor and is selected by the bandwidth switch on the front panel.

5-47. The output signal from the IF filter has two possible paths. The path to the Log Amplifier and Detector provides the spectrum analyzer capability. The other path is the linear IF Amplifier for AM, FM, and SSB demodulation. The output level of the Amplifier is detected to give amplitude modulation and to provide the AGC control on the IF amplifier. The IF signal is applied to the FM Demodulator and is sent to the Scope/DVM Control module (A3) for SSB demodulation and for frequency error determination.

5-48. Demodulated audio from the selected demodulator is routed to the Audio Filter by the Select Switch under processor control. The Audio Filter provides post detection filtering for both wide and narrow band modes. The output of the Audio Filter is three signal lines. The Demod Calibration Audio line provides the calibrated audio levels for modulation level determination. A Demod Audio output provides a level adjusted signal to the front panel Demod Out jack. Speaker audio is level adjusted by the front panel volume control and then amplified by the Audio Amplifier on the Receiver module.

5-49. The Audio Amplifier sums the audio from the demodulator with the Alarm audio. The Audio Amplifier provides a 0.5 watt output capability to the system's internal speaker. The Alarm generator is under the control of the system processor.

5-50. SSB demodulation is implemented on the Scope/DVM Control module by multiplying the 455 kHz IF signal from the Receiver with a signal from the Beat Frequency Oscillator (BFO). The BFO is controlled from the front panel and typically has a frequency range of 455±3 kHz. The BFO signal is switched with the output of the 455 kHz IF Phased Locked Loop (PLL) to the frequency counter for frequency error determination. The 455 kHz PLL filters and shapes the IF signal to make it suitable for frequency counting.

5-51. When in the spectrum analyzer mode the linear IF Amplifier is shut down and the Log Amplifier is activated. The output of the Log Amplifier and Detector is a DC voltage that is proportional to the log of the 10.7 MHz IF input level. The log circuit has a dynamic range of approximately 80 dB, covering input levels from −110 dBm to −30 dBm. The SPECTRUM ANALYZER signal from the Log Amplifier is the vertical input to the scope for the spectrum analyzer display.

### 5-52 Duplex Generator

5-53. Simultaneous generate and monitor functions are available with the use of the Duplex Generator. The frequency spread between generate and monitor frequencies is limited to a range of 0 to 10 MHz and a fixed frequency of 45 MHz. A block diagram of the Duplex Generator function is shown in figure 5-7.

5-54. The Duplex Output signal is generated by mixing the local oscillator signal for the first receive mixer with a signal from the Offset Oscillator. The Offset Oscillator is at the frequency equal to the desired spread between generate and monitor frequencies less the 10.7 MHz IF offset. The monitor function is unaffected by the duplex mode and operates as described under paragraph 5-40.

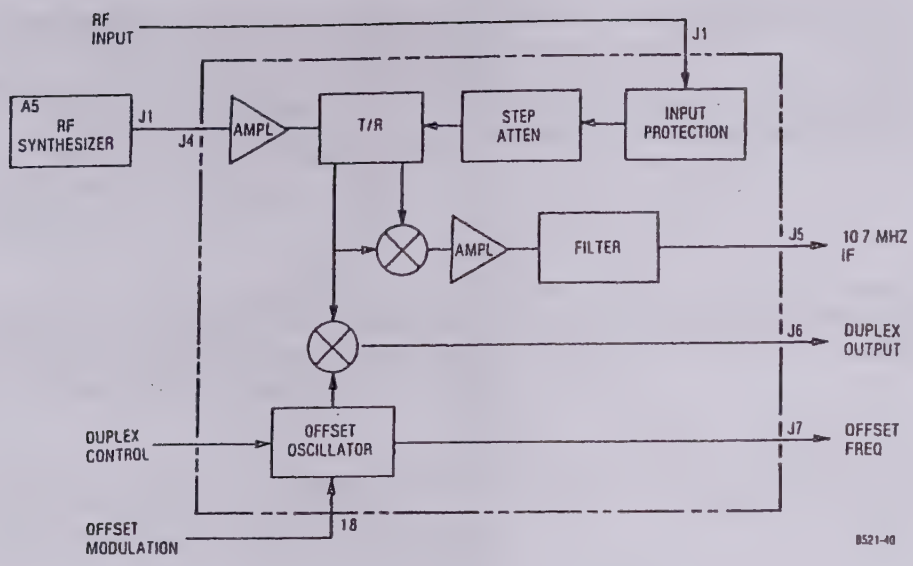



Figure 5-7. Duplex Generator Block Diagram

5-55. Frequency modulation of the duplex output is obtained by modulating the Offset Oscillator frequency via the OFFSET MOD signal line. Control of the Offset Oscillator is directly from the front panel of the system. An OFFSET FREQUENCY output from the oscillator provides an input to the frequency counter for the determination of the duplex frequency.

**5-56. Code Synthesizer**

5-57. Three simultaneous modulation sources are possible with the internal Code synthesizer. A private line (PL) or Digital Private Line (DPL) source, a fixed 1 kHz source, and external modulation sources are individually level controllable and summed together to give the composite modulation audio. The Code Synthesizer provides the modulation source for the system in the generate mode and can be used as an audio frequency source when in the monitor mode. For the IEEE option a provision is made to allow processor control of the modulation levels. A block diagram of the Code synthesizer is shown in figure 5-8.

5-58. The PL signaling sequence generator is an Audio Synthesizer with an output frequency range from 5 Hz to 10 kHz in 0.1 Hz steps. The frequency is programmed by the processor in response to the operator's request from the keyboard through the CRT display. The Programmable Attenuator following the synthesizer provides 10 dB and 30 dB attenuation levels for the tone remote access sequence.

5-59. DPL Code words are generated by the processor in response to the code entered by the operator. The 23-bit DPL word is stored in the DPL Generator and contunuously output when selected. Either PL or DPL signals are switched to the Code Synthesizer Level control on the front panel.

5-60. A 1 kHz reference signal from the RF Synthesizer is bandpass filtered to provide a low distortion 1 kHz sinewave to the front panel 1 kHz Level Control.

5-61. Two sources of external modulation are possible. A standard Motorola microphone interface jack on the front panel and a BNC front panel jack are provided. The microphone input is connected to an IDC circuit for peak limiting. The composite of the two external modulation sources is the signal to the External Level control on the front panel.

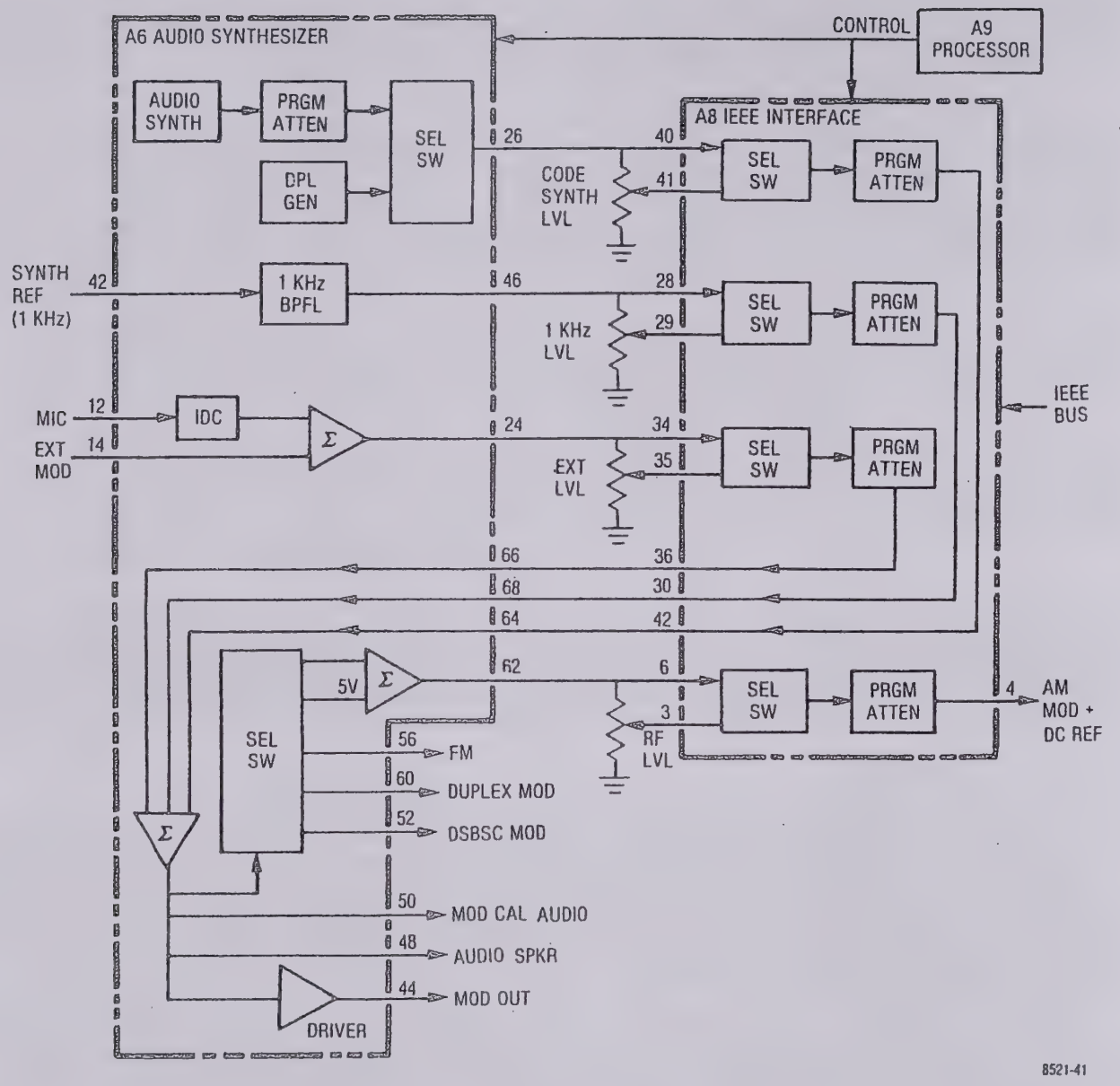



Figure 5-8. Code Synthesizer Block Diagram

5-62. Systems without the IEEE option will have the wipers of the level control pots jumpered to their respective inputs to the summation amp on the Audio Synthesizer module (A6). Those systems with the IEEE option will select on the IEEE Interface module (A8) either the tops of the level controls or their wipers to the Programmable Attenuators for remote or local control respectively. While in the IEEE Control mode the processor controlled Programmable Attenuator on the IEEE module provides the modulation level control. For the local mode the attenuators are programmed for zero attenuation so that the wipers of the level control set the modulation levels directly.

5-63. The three modulation sources are summed together on the Audio Synthesizer module after the level controls. The composite modulation signal is then switched to the appropriate modulator and applied to the modulation determination circuitry (MOD CAL AUDIO), the audio amplifier (SPKR AUDIO), and the Modulation Output jack (MOD OUT) on the front panel. The signal to the front panel jack is buffered by a Driver Amplifier to provide a low driving source impedance.

5-64. The AM modulation signal at the output of the Select Switch is summed with a +5 volt signal. This combination provides a DC level to control the average output power of the wideband amp in the RF Input module, and a superimposed modulation signal to give AM. The RF Level control on the front panel for local control or the Programmable Attenuator on the IEEE module provide local or remote RF level control by simultaneously attenuating the DC level and the modulating signal. The resulting signal is the AM MOD & DC REFERENCE signal to the RF Input module.

### 5-65 Frequency Counter

5-66. Three possible signal sources are made available to the frequency counter for frequency determination. Two of the inputs are from internal system points for the determinations of the offset frequency (OFFSET), and the monitored carrier error frequency (IF/BFO)). The third input is the external input (FREQ CNTR INPUT) on the front panel. A block diagram of the frequency counter function is shown in figure 5-9.

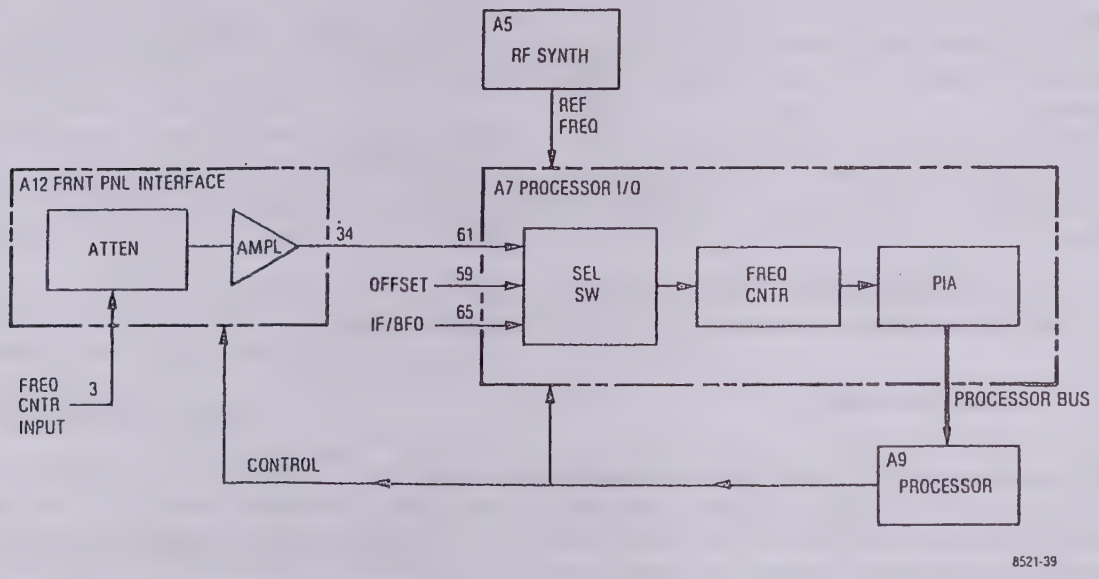



Figure 5-9. Frequency Counter Block Diagram

5-67. The external input signal is routed to the Front Panel Interface module (A12). A range Attenuator on the Interface module provides variable sensitivity settings according to the vertical range switch setting on the front panel. An Amplifier following the range Attenuator amplifies and limits the signal amplitude for the frequency counter input.

5-68. A Select Switch on the Processor I/O module (A7) routes the desired signal to the Frequency Counter circuitry. The signal selected is controlled by the processor and is determined by the operating mode of the system.

5-69. A 16-bit gated accumulator is used to determine the input frequency. Gate times from 1 msec to 10 sec are automatically selected by the processor to give the maximum possible resolution. The gate times are derived from the RF Synthesizer REFERENCE FREQUENCIES and thus are as accurate as the system time base.

5-70. The 16-bit Frequency Counter output is transferred directly to the processor bus through a Peripheral Interface Adapter (PIA). The processor in turn adjusts the data for the gate time used and then processes the information to obtain the required frequency display.

## 5-71. Digital Voltmeter (DVM)

5-72. The processor through the DVM circuitry has access to voltage information at a large number of points throughout the system. From this information the processor is able to determine and display parameters such as output power level, modulation level, input power level and the like. In addition, an external voltage applied to th DVM input jack on the front panel can be measured and displayed for external voltage measurements. A block diagram of the DVM function is shown in figure 5-10.

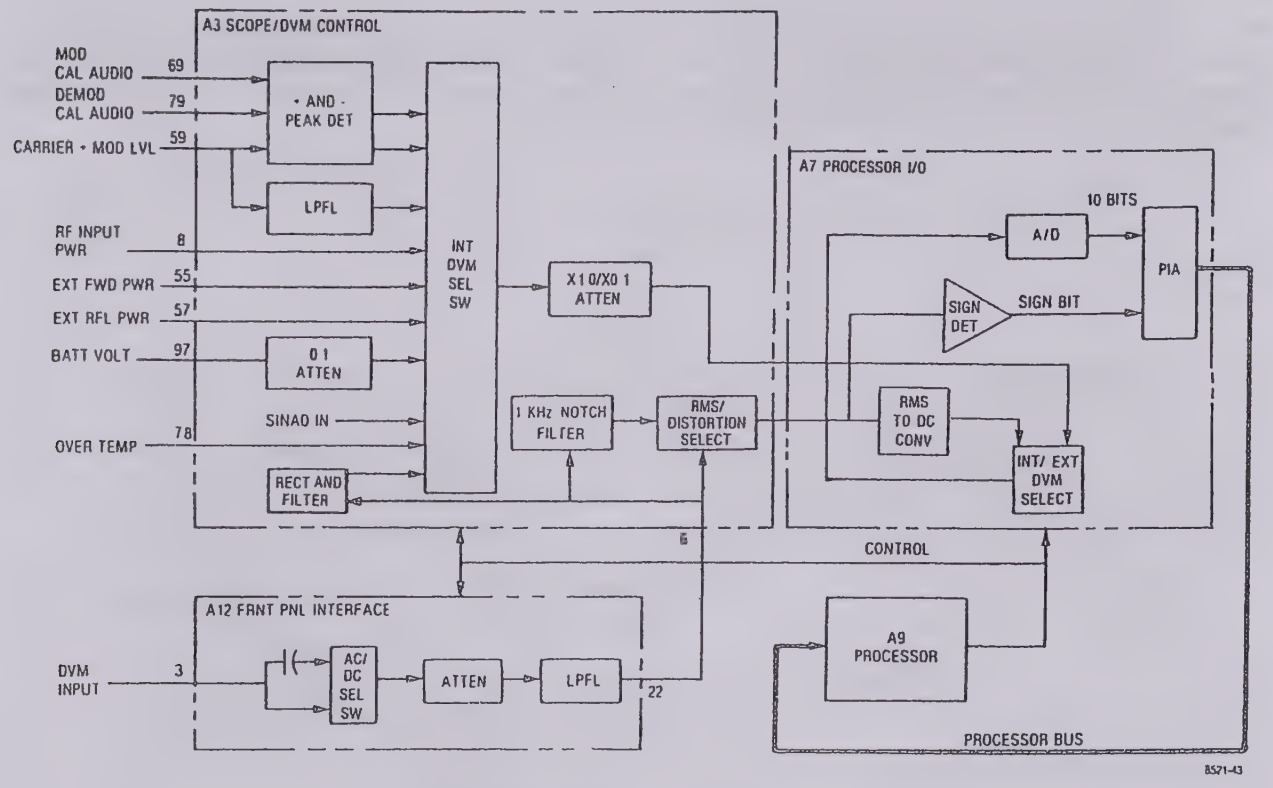



Figure 5-10. Block Diagram DVM/Distortion Analyzer

5-73. Internal voltage measurements are selected and ranged over two decades by the INT DVM SELECT SWITCH and the X1.0/X0.1 attenuator respectively on the Scope/DVM Control (A3) module. The resulting 0 to 1 VDC signal is routed to the INT/EXT DVM SELECT SWITCH on the Processor Interface (A7) module which applies the voltage to the A/D converter. The A/D converter converts the input voltage into a 10 bit digital word which is input to the processor. One of eight internal voltages may be selected for measurement as required by the processor to determine display data. Inputs to the A/D must be less than 1 VDC; therefore, with the decade X1/X.1 ranging attenuator the maximum input voltage to the internal DVM is 10 VDC. The X1 position of the attenuator is switched in for better voltage reading resolution on voltages less than 1 VDC. To keep CRT information current, each of the required measurements are made in sequence at an approximate rate of thirty per second.

5-74. Two modulation signals (MOD CAL AUDIO and CARRIER + MOD LVL) and a demodulated signal (DEMOD CAL AUDIO) are made available to the peak detectors. Positive and negative peak determination of the selected signal enables the processor to determine the level of modulation.

5-75. A Lowpass Filter (LPFL) removes the DC component from the CARRIER + MOD LVL signal so that the generate RF output level can be determined. Refer to paragraph 5-30.

5-76. The RF INPUT POWER and OVERTEMP signal lines from the RF Input module provide the processor inputs for the internal wattmeter. (Paragraph 5-38). External wattmeter element inputs (EXT FWD PWR and EXT RFL PWR) from the front panel jack provide the information for the external wattmeter display.

77. A signal line from the DC input jack on the rear panel (BATT VOLT) is brought to the processor for battery voltage determination. The voltage is attenuated by a factor of 10 to stay with the 10 volt maximum input to the select switch. The processor uses the battery voltage measurement to warn the operator when the battery is near its discharged state.

5-78. A rectified and filtered version of the input to the 1 kHz NOTCH FILTER is the last internal measurement point. This measurement is used as part of the distortion/SINAD reading. For further information on the distortion/SINAD meter see paragraph 5-82.

5-79. EXTERNAL DVM — In the external DVM mode, voltages applied to the Ext DVM Input Jack on the front panel are ranged by processor control over four decades in the Front Panel Interface (A12) module. The result is a 0 to 1 VRMS signal at the output of the attenuator for inputs of 0 to 300 VRMS. The signal is routed directly through the A3 module by the RMS/Distortion Select Switch to the RMS to DC Converter on the A7 module. The INT/EXT DVM Select Switch applied the output of the RMS to DC Converter to the A/D converter for input to the processor.

5-80. For external DC measurements the AC/DC Select Switch selects the DC coupled path from the Ext DVM Input Jack. A low pass filter (LPFL) in the A12 module removes ripple components. The rejection at 50 Hz is 25 dB in the low pass filter. The RMS to DC Converter reads the absolute value of the DC input, and the sign detector (SIGN DET) provides polarity information.

5-81. For AC voltage measurements the LPFL is reprogrammed for less than 0.5 dB attenuation out to 10 kHz. The AC/DC Select Switch selects the AC coupled path, and the RMS to DC Converter converts the AC input into a DC voltage equal to the RMS voltage of the input.

### 82. Distortion/SINAD Meter

83. The distortion of a signal with a 1 kHz fundamental frequency can be measured by the R2001C. The 1 kHz input enters the EXT DVM input jack through the AC coupled path and is ranged to between 0 and 1 volt RMS by the ranging attenuator. The signal is routed through the notch filter where the fundamental frequency is removed. The output of the notch filter is selected to the RMS to DC Converter input by the RMS/Distortion Select Switch where the RMS voltage of the distortion components (to 10 kHz) is measured. The input of the notch is rectified, filtered, and multiplied by 1.11 (the RMS to AVERAGE ratio for a sinusoid). The resulting DC voltage is measured by the internal DVM as described in paragraph 5-73. The processor divides the RMS output voltage of the notch filter by the RMS input voltage to the notch filter to obtain a distortion ratio. The distortion ratio is converted to dB by the processor for the SINAD display. The percent distortion display is obtained by multiplying the distortion ratio by 100.

### 5-84. Oscilloscope

5-85. Three basic functions are provided for by the system oscilloscope. The alphanumeric and modulation displays provide operating mode and control information for the system. The external oscilloscope feature augments the total system as a general purpose test instrument. A block diagram of the oscilloscope function is shown in figure 5-11.

5-86. Drive signals for the CRT are provided by circuits on the Scope Amplifier module (A2). Horizontal and vertical signals are amplified by their respective amplifiers from 0.5 volt/division input levels to the levels required on the deflection plates. A Z-Axis Modulator circuit controls the cathode to grid bias voltage on the CRT to effect intensity control.

5-87. The horizontal amplifier input is selected between external and internal scope functions. External functions, Time base Generator or external horizontal input, are switched to a summation amp where the HORIZONTAL POSITION signal from the front panel is added. The resulting DC offset positions the display horizontally on the CRT.

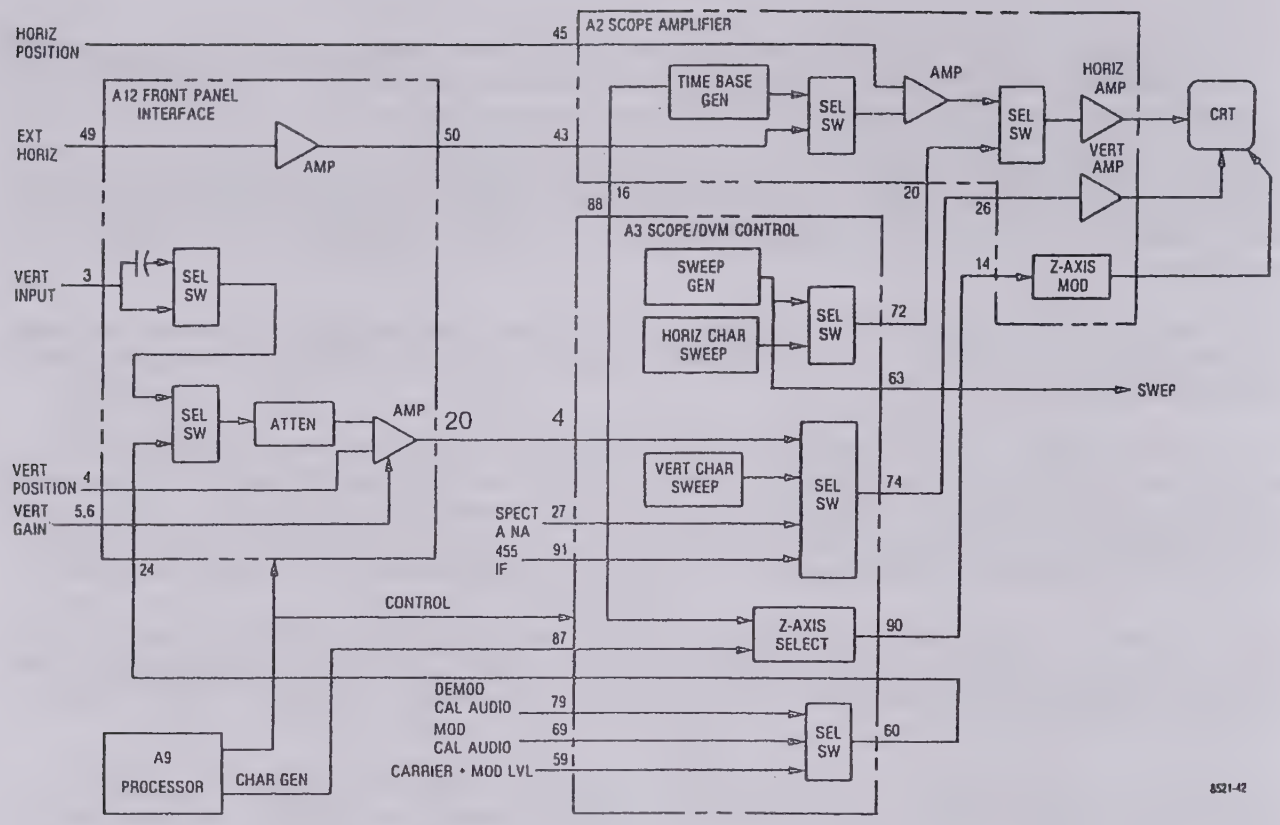



Figure 5-11. Oscilloscope Block Diagram

5-88. Six decade sweep ranges from 1 $\mu$sec to 100 msec per division are provided by the Time base Generator. Control of the Time base Generator is from the front panel horizontal switch through the processor.

5-89. Front panel external horizontal inputs are applied to the top of the horizontal vernier gain potentiometer. The wiper of the gain potentiometer is the EXTERNAL HORIZONTAL input signal to the preamp on the Front Panel Interface module (A12). The preamp provides the required horizontal input sensitivity and buffers the signal to the select switch on the Scope Amplifier module.

5-90. Internal horizontal signals, Sweep Generator and Character Sweep outputs, are selected on the Scope/DVM Control module (A3). The Sweep Generator provides a sawtooth waveform to the RF Synthesizer module for the sweep generator and spectrum analyzer functions. The sweep signal to the CRT horizontal input causes the scope sweep to be synchronous with the synthesizer sweep for the spectrum and swept filter response displays.

5-91. The Horizontal Character Sweep generator output is a sawtooth waveform that provides the horizontal sweep for the raster scan character display.

5-92. One of four possible vertical signal sources are switched to the Vertical Amplifier input by a Select Switch on the Scope/DVM Control module. The 455 kHz IF and SPECTRUM ANALYZER signals from the Receiver Module provide the IF envelope and spectrum analyzer displays respectively. The Vertical Character Sweep generator gives the vertical sweep for the raster scan character display. The remaining input is the path for external vertical or modulation scope vertical inputs from the Front Panel Interface module.

5-93. A vertical preamplifier on the Interface module gives a vertical sensitivity of 10 millivolt per division and provides positioning and vernier gain capability for its input. The amplifier is preceded by a four decade range attenuator

which is controlled from the front panel vertical switch through the processor. The attenuator provides external vertical input sensitivities from 0.01 to 1.0 volt per division and modulation scope sensitivities from 0.25 to 25 kHz per division.

5-94. A Select Switch ahead of the Attenuator selects between the external vertical input or the modulation scope inputs. The External Vertical input path is further selected between AC and DC coupling before becoming the vertical input jack on the front panel. The modulation scope signal path is switched to one of three possible sources on the Scope/DVM Control module. Demodulation signals from the Receiver are selected via the DEMOD CAL AUDIO path, and frequency and amplitude modulation signals via the MOD CAL AUDIO and CARRIER + MOD LVL signal paths respectively. The Audio Synthesizer module provides the MOD CAL AUDIO signal while the RF Input module gives the CARRIER + MOD LVL signal.

5-95. A Z-Axis Select circuit on the Scope/DVM Control module gates either the CHARACTER GEN signal for character displays or the retrace blanking signal from the Time Base Generator for scope displays to the Z-Axis Modulator on the Scope Amplifier module.

## 5-96. ALIGNMENT PROCEDURE

### 5-97. Introduction

5-98. This section provides a basic (para 5-102) and an extended (para 5-115) alignment procedure. The basic procedure requires only the use of a calibrated oscilloscope. It is expected that the basic alignment be performed whenever service work is performed. The extended alignment procedure requires module extenders and a calibrated digital voltmeter in addition to the oscilloscope. The extended procedure should be performed as required after servicing the system. All adjustments not covered in this procedure are to be performed on suitable module test fixtures only.

### 5-99. Test Equipment Required

5-100. The test equipment or its equivalent listed in table 5-3 is required for the basic procedure. The additional equipment required for the extended procedure is listed in table 5-4.

Table 5-3. Basic Test Equipment Required

| Description | Model |
|---|---|
| *Oscilloscope | Motorola R1029A |
| Test Point Shorting Jumper | |
| Nonmetallic Alignment Tool | |

*An R2001 is a suitable substitute

Table 5-4. Extended Test Equipment Required

| Description | Model |
|---|---|
| *Oscilloscope | Motorola R1029A |
| *Digital Voltmeter | Motorola R1024A |
| *RF Signal Generator | Motorola R1201A |
| *Modulation Meter | Boonton 82AD |
| Audio Generator | Motorola S1067 |
| Receiver Test Cover | Motorola 15-80346A49 |
| Extender Card Set | Motorola RPX-4150A |

*An R2001 is suitable for use in place of these separate equipments.

## 5-101. Preparation for Alignment

1. All alignments to be performed at normal ambient temperature.

2. Remove the top cover of the unit to be aligned.

3. Apply power to the unit to be aligned and allow a warmup time of 15 minutes prior to alignment.

## 5-102. Basic Alignment Procedure

5-103. CRT Astigmatism and Geometry

1. Select the Monitor Function and the Gen/Mon Mtr Display on the R2001C. Set the Intensity Control for a medium intense display.

2. While using the Focus Control to maintain a focused display at the center of the CRT, adjust the Astigmatism and Geometry potentiometers (Figure 5-12) for the best focus at the outer edges of the CRT while minimizing the pincushion and barrel distortion of the display. The two adjustments are interactive so that repeated small adjustments alternated between the two potentiometers will be required to obtain the best display.

5-104. CRT Intensity Bias

1. Select the Scope DC Display and the Ext Horiz. Input mode. Set the Intensity Control fully counter clockwise.

**CAUTION**

Do not let a dot stay in one place on the CRT screen for more than 30 seconds as a permanent burn in the phosphor will occur.

2. Adjust the Intensity Bias potentiometer (Figure 5-12) until a dot appears on the screen. (The Vertical and Horizontal Position Control on the front panel may have to be used to bring the dot on to the screen.) Then back off the Intensity Bias potentiometer until the dot just disappears.

5-105. CRT Intensity Balance

1. Select the Scope DC Display and the 1 mSec/Div Horizontal Sweep rate on the R2001C. Set the Horizontal Timebase Vernier to the Cal position and adjust the Intensity Control for a barely visible horizontal line on the CRT.

2. Adjust the Intensity Balance potentiometer (Figure 5-12) for uniform intensity of the horizontal trace from left to right. The Balance potentiometer affects the intensity on the left side of the trace.

5-106. CRT Horizontal Centering

1. Select the Gen/Mon Mtr Display on the R2001C. Adjust the Intensity Control for a comfortable viewing brightness.

2. With the Test Point Shorting Jumper connect TP1 of the Scope Amplifier Board (Figure 5-12) to chassis ground.

3. Adjust the Horizontal Position Potentiometer (Figure 5-12) so that the vertical trace on the CRT screen passes through the graticule center point.

4. Remove the jumper from TP1.

5-107. CRT Vertical Centering

1. Select the Gen/Mon Mtr Display on the R2001C. Adjust the Intensity Control for comfortable viewing brightness.
2. With the Test Point Shorting Jumper connect TP4 of the Scope Amplifier Board (Figure 5-12) to chassis ground.
3. Adjust the Vertical Position Potentiometer (Figure 5-12) so that the horizontal trace on the CRT screen passes through the graticule center point.
4. Remove jumper from TP4.

5-108. CRT Trace Rotation

1. Select the Gen/Mon Mtr Display on the R2001C. Adjust the Intensity Control for a comfortable viewing brightness.
2. Adjust the Trace Rotation Potentiometer (Figure 5-12) for a properly rotated CRT display.

5-109. CRT Horizontal Gain

1. Connect the Mod Out Jack to the Ext Horiz Jack on the R2001C front panel.
2. Set the R2001C for the Generate FM Function and the Scope DC Display. Set the Horiz Control for Ext Horiz input. Turn the Code Synthesizer off, the Ext Level off, and the 1 kHz Level up about half way.
3. Connect an oscilloscope with a calibrated vertical input to TP1 on the Scope Amplifier Board. (Figure 5-12).
4. Using the front panel Horizontal Vernier Control adjust for a 3V p-p amplitude on the sinewave at TP1.
5. With 3V p-p at TP1 adjust the Horizontal Gain Potentiometer (Figure 5-12) for a horizontal trace 6 cm long on the CRT. (Use the front panel controls to position the trace at a convenient place near the center of the CRT).

5-110. CRT Vertical Gain

1. Connect the Mod Out Jack to the Vert Input Jack on the R2001C front panel.
2. Set the R2001C for the Generate FM Function and the Scope DC Display. Set the Horiz Control for 1 mSec/Div sweep rate and the Horizontal Vernier to the Cal position. Set the Vert Control for 1 V/Div input sensitivity and the Vertical Vernier to the Cal position.
3. Turn the Code Synthesizer off, the Ext Level off and the 1 kHz Level up about half way.
4. Connect an oscilloscope with a calibrated vertical input to TP4 on the Scope Amplifier Board. (Figure 5-12).
5. Using the front panel 1 kHz Level Control adjust for a 3V p-p amplitude on the sinewave at TP4.
6. With 3V p-p at TP4 adjust the Vertical Gain Potentiometer (Figure 5-12) for a 6 cm p-p sinewave on the CRT. (use the front panel Position Controls to center the waveform on the CRT).

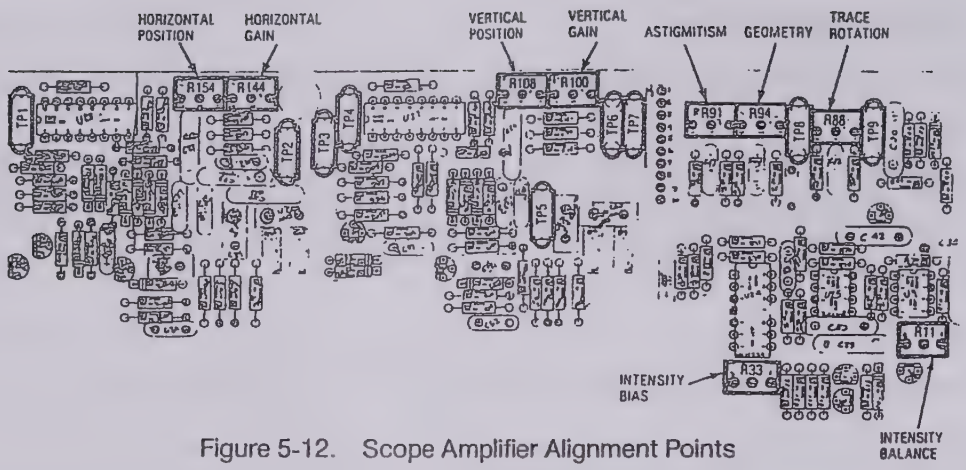



Figure 5-12. Scope Amplifier Alignment Points

5-111. Vertical Input Gain

1. Set the R2001C for the Generate FM Function and the Scope DC Display. Set the Horiz Control for 1m Sec/Div sweep rate and the Horizontal Vernier to the Cal position. Set the Vert Control for 1V/Div input sensitivity and the Vertical Vernier to the Cal position.

2. Connect an oscilloscope with a calibrated vertical input to the Mod Out Jack on the front panel.

3. Turn the Code Synthesizer off, the Ext Level off and adjust the 1 kHz Level Control for a 6V p-p sinewave on the attached oscilloscope.

4. Disconnect the oscilloscope from the Mod Out Jack and connect the Mod Out Jack to the Vert Input Jack on the R2001C.

5. Adjust the Input Vertical Gain Potentiometer on the Front Panel Interface Board (Figure 5-13) for a 6 cm p-p sinewave on the CRT. (Use the front panel Position Controls to center the waveform on the CRT.)

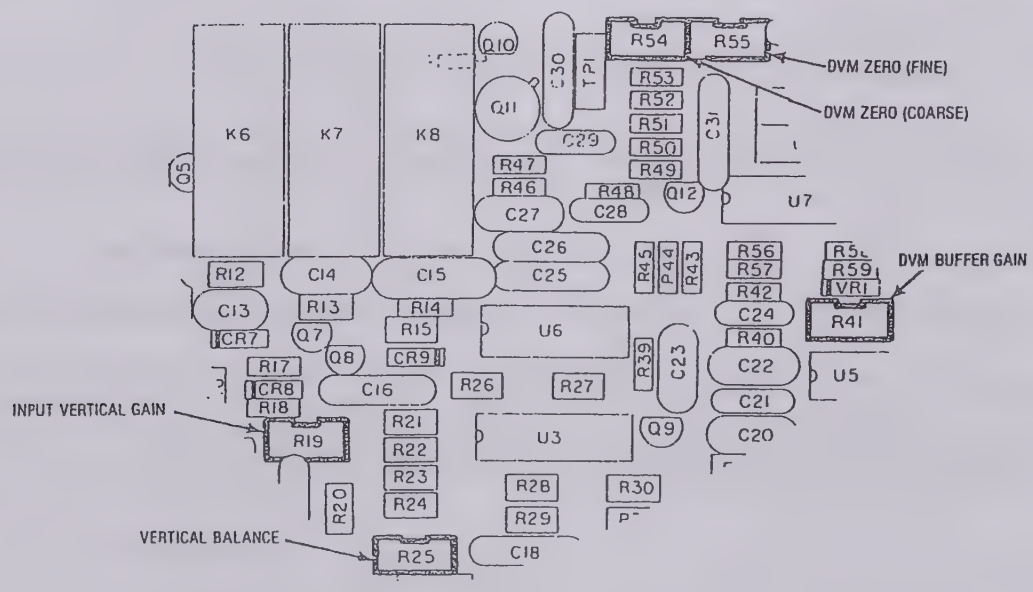



Figure 5-13. Front Panel Interface Alignment Points

5-112. DVM Zero

1. Select the DVM Display and the DC Mode on the R2001C.

2. Short the center conductor of the DVM Input Jack to ground.

3. Adjust the DVM Zero (Coarse) and the DVM Zero (Fine) Potentiometers on the Front Panel Interface Board (Figure 5-13) for a zero reading on the DVM Display.

5-113. Spectrum Analyzer Centering

1. Select the Spect Analyzer Display on the R2001C. Set the Dispersion Control on the front panel to the 1 MHz position. (full counter clockwise) Set the center frequency of the analyzer to 10.0 MHz.

2. Connect the 10 MHz Output on the rear panel to the RF Input on the front panel. Set the RF Step Attenuator to obtain a convenient spectral display.

3. Adjust the Spectrum Analyzer Centering Potentiometer on the Scope/DVM Control Board (Figure 5-14) so that the spectral line on the CRT is centered about the center graticule line.

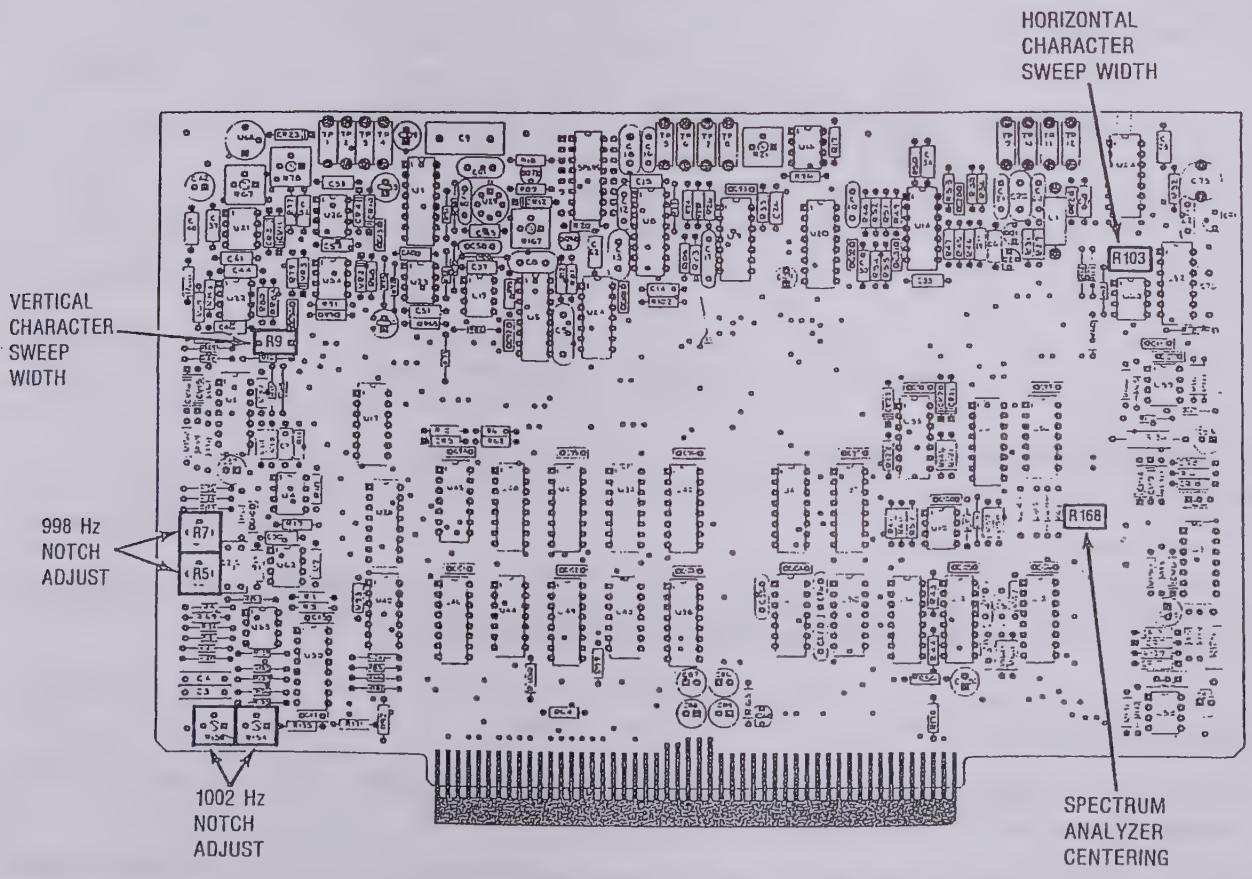



Figure 5-14. Scope/DVM Control Alignment Points

5-114. Horizontal Time Base

1. Select the Tone Memory Display and the Generate FM Function on the R2001C. Program tone A for 20.0 Hz and Tone B for 2000.0 Hz.

2. Select the Modulation Display. Set the Oscilloscope Controls for 2.5 kHz/Div vertical range, Auto Trigger, and 10 mSec/Div horizontal sweep range. Set the Horizontal and Vertical Vernier Controls to their Cal positions.

3. Set the Code Synthesizer for Continuous, Tone A, and turn up the Code Synth Level to obtain a nearly full scale sinusoidal waveform on the CRT. Turn the Ext Level and the 1 kHz Level Controls to the off position.

4. Adjust the Coarse Time Base Calibration Potentiometer on the Scope Amplifier Board (Figure 5-15) so that one cycle of the displayed waveform occurs in 5 cm along the horizontal axis. Use the Vertical and Horizontal Position controls to center and to move the waveform so that the 5 cm are measured in the middle of the screen to avoid nonlinearities near the edge of the CRT.

5. Set the Oscilloscope Horizontal Control for a 100 $\mu$Sec/Div sweep rate and select the Tone B output on the Code Synthesizer.

6. Adjust the Fine Time Base Calibration Capacitor on the Scope Amplifier Board (Figure 5-15) so that one cycle of the displayed waveform occurs in 5 cm along the horizontal axis. Use the Vertical and Horizontal Position controls to center and to move the waveform so that the 5 cm are measured in the middle of the screen to avoid nonlinearities near the edge of the CRT.

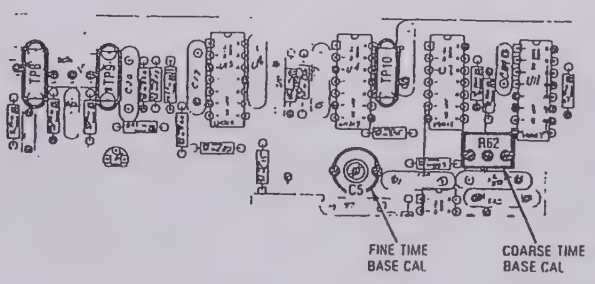



Figure 5-15. Horizontal Time Base Alignment Points

5-115. EXTENDED ALIGNMENT PROCEDURE

5-116. DVM

1. Remove the R2001C top cover.

2. Connect the R2001C to a primary power source, turn it on, and select the EXT DVM mode. Allow approximately 15 minutes warmup before proceeding with the alignment procedure.

3. Short the center conductor of the DVM input jack on the front panel to ground. Connect an external DVM between TP2 and TP9 of the Scope DVM Control Board (Figure 5-14).

4. Adjust the Coarse DVM Zero and the Fine DVM Zero on the Front Panel Interface Board (Figure 5-13) until the external DVM reads 0 $\pm$ 0.5 millivolts DC.

5. Remove the short circuit on the DVM input jack and apply approximately 0.900 volts DC from an external power supply. The voltage between TP2 and TP9 of the Scope/DVM Control Board should be within $\pm$1 mv of the voltage at the front panal DVM input jack. If the unit fails this test, adjust the DVM Buffer Gain on the Front Panel Interface Board (Figure 5-13) until the above two voltages are equal.

6. Select the generate FM narrowband mode and the Gen/Mon Metering display.

7. Short TP4 to TP9 on the Scope/DVM Control Board.

8. Adjust the A/D Offset on the Processor Interface Board (Figure 5-16) until the plus peak deviation reading on the CRT is just toggling between 0.00 and 0.01 kHz. Then slightly turn the adjustment just enough to make the reading 0.00 all the time. Note that if the offset adjustment is turned past this point the deviation reading is still 0.00 but the A/D converter is not aligned properly.

9. Remove the short circuit between TP4 and TP9, and connect the positive lead of the external DVM to TP4 of the Scope/DVM Control Board module. Place the negative lead on the ground plane or TP9 of the Scope/DVM Control Board.

10. Turn on the 1 kHz internal modulation and adjust the level until the voltage TP4 reads 0.900 volts.

11. Adjust the A/D Gain (Figure 5-16) until the reading on the positive deviation peak is 4.50 kHz.

12. Select the DC DVM mode.

13. With the center conductor of the front panel DVM input jack again shorted to ground, adjust the RMS Converter offset on the Processor Interface Board (Figure 5-16) for a reading of 0.000 volts on the CRT DVM display.

14. Adjust the sign detector offset (Figure 5-16) until the sign of the 0.000 volt reading is just flashing between plus and minus.

15. Remove the short and apply approximately 0.900 volts to the front panel. DVM input jack.

16. While monitoring the input voltage on an external DVM, adjust the RMS Converter Gain on the Processor Interface Board (Figure 5-16) until the CRT DVM reading is equal to the external voltage applied.

5-117. Character Generator

1. Perform the Basic Alignment Procedure of para 5-102.

2. Select the Monitor FM Function and the Gen/Mon Mtr Display.

3. Adjust the Horizontal Character Sweep Width Potentiometer on the Scope/DVM Control Board (Figure 5-14) so that the right-hand edge of the CRT character display is approximately 4.2 graticule divisions to the right of the graticule center line.

4. Adjust the Vertical Character Sweep Width Potentiometer on the Scope/DVM Control Board (Figure 5-14) so that the bottom edge of the CRT display is approximately 3.3 graticule divisions below the graticule center line.

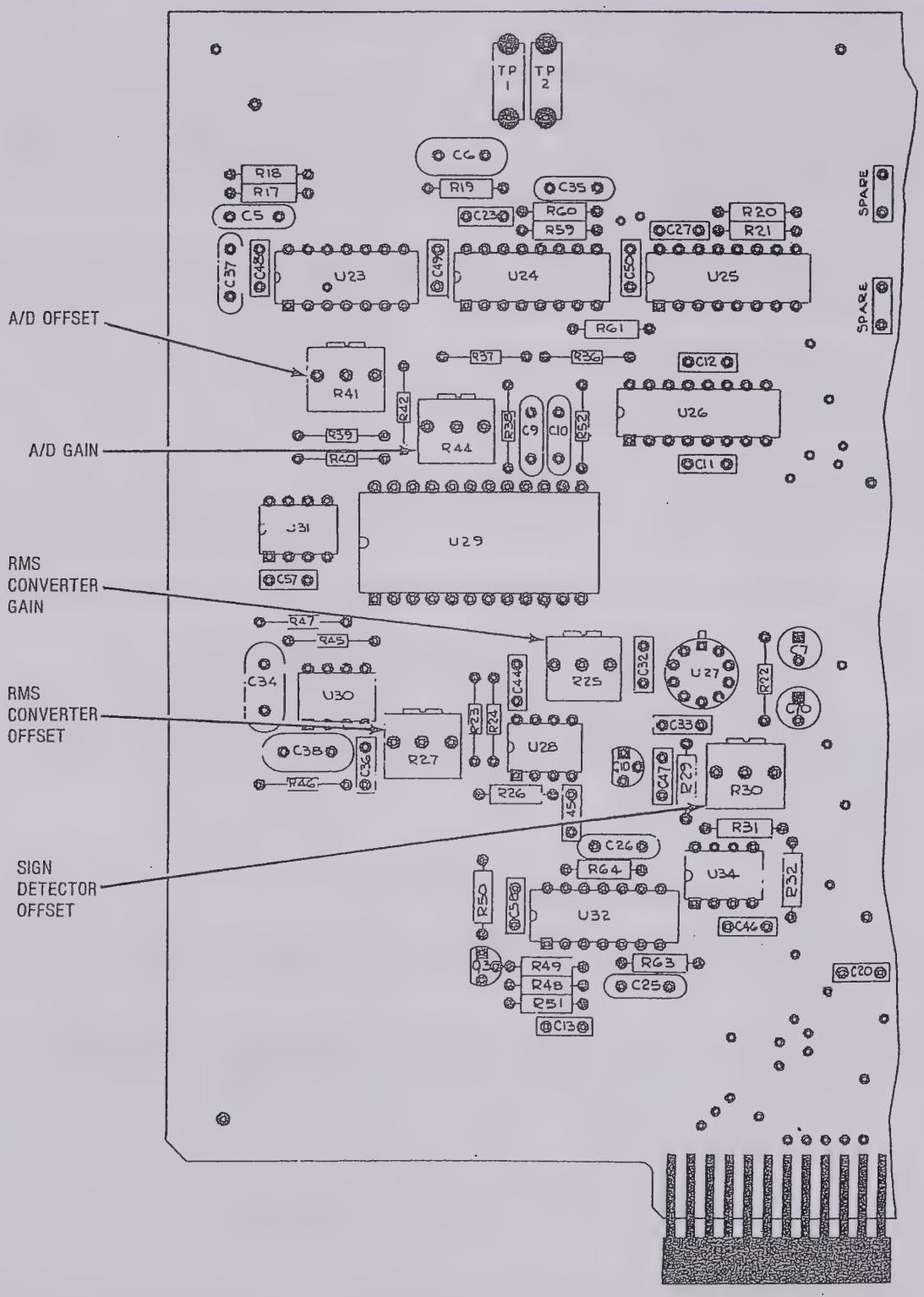



Figure 5-16. Processor I/O A/D Alignment Points

## 5-118. DISTORTION/SINAD ALIGNMENT

1. Enter the generate mode and the Gen/Mon Metering display. Using an audio generator with less than 0.1% distortion apply a 900 mVRMS 1 kHz ± 2 Hz signal to the Vert Sinad/DVM Dist/Counter In input on the front panel.
2. Verify that the distortion reading on the CRT is ≤0.5%. If this test fails the notch filter should be aligned.
3. Turn the R2001C off and extend the Scope/DVM Control Board using the 100 pin extender card.
4. Turn the R2001C on and select the generate FM mode and the Gen/Mon Metering display.
5. Using the same low distortion generator as in article 1, apply a 998 ± 0.2 Hz sine wave to the Distortion input.
6. Alternately adjust the 998 Hz notch potentiometers on the Scope/DVM Control Board (Figure 5-14) to null the distortion reading on the CRT. A reading less than 0.5% should be obtained.
7. Change the audio generator input frequency to 1002 ± 0.2 Hz.
8. Alternately adjust the 1002 Hz notch potentiometers on the Scope/DVM Control Board (Figure 5-14) to again null the CRT distortion reading. A reading less than 0.5% should be obtained.
9. Turn the system power off and reinstall the Scope/DVM Control Board into the R2001C.

5-119. Receiver

5-120. AM Detector

1. Perform the basic alignment procedure of para 5-102.
2. Turn the R2001C off and remove the Receiver Module. Remove the Receiver Module cover and install the Receiver Test Cover on the module housing. Extend the Receiver module on the Receiver Extender Card.
3. Turn the R2001C on and select the Monitor AM Function and the Gen/Mon Mtr Display. Set the monitor frequency to 250 MHz, the RF Step Attenuator to the 0 dB position, and the BW Switch to the Narrow position.
4. Connect the external signal generator to the RF In/Out Jack on the front panel. Adjust the external generator for an output level of approxiamtely −60 dBm and a calibrated 30% AM.
5. Adjust R60 (Marked on the Receiver Test Cover) for a reading of 30% ±5% on the CRT AM display.

5-121. FM Detector

1. Select the Monitor FM Function and the Gen/Mon Mtr Display. Set the monitor frequency to 250 MHz, the RF Step Attenuator to the 0 dB position, and the BW Switch to the Wide position.
2. Connect the external signal generator to the RF In/Out Jack on the front panel. Adjust the external generator for a center frequency of 250 MHz at an output level of approximately −30 dBm and a calibrated 20 kHz FM.
3. Adjust R70 (Marked on the Receiver Test Cover) for a reading of 20 kHz ± 1 kHz on the CRT FM display.
4. Set the BW switch to the Narrow position and reset the FM on the external generator to 3 kHz deviation
5. Adjust R125 (Marked on the Receiver Test Cover) for a reading of 3 kHz ± 150 Hz on the CRT FM display.

6. Turn off the FM on the external generator so that a CW signal of a level of approximately −30 dBm is applied to the R2001C.

7. Connect the Demod Out Jack to the Vert/Sinad Dist/DVM/Counter Input Jack on the front panel. Select the DVM Display and the DC DVM Mode on the R2001C.

8. Adjust R68 (Marked on the Receiver Test Cover) for a 0.0 VDC ± 100 mVDC reading on the DVM Display.

5-122. Spectrum Analyzer

1. Select the Monitor Function and the Spectrum Analyzer Display on the R2001C. Set the monitor frequency to 250 MHz, and the RF Step Attenuator to the 40 dB position.

2. Connect the external signal generator to the RF In/Out Jack on the front panel. Adjust the external generator for a center frequency of 250 MHz and a calibrated output level of −30 dBm with no modulation.

3. Adjust in succession C2, C83, C88, and C96 (Marked on the Receiver Test Cover) to maximize the amplitude of the spectral line in the center of the CRT display.

4. Adjust R124, R91, and R100 (Marked on the Receiver Test Cover) to obtain a uniform change in the spectral amplitude per 10 dB change of the RF Step Attenuator. R124 affects the level of the spectral component when in the top quarter of the screen, R91 affects levels in the third quarter from the top, and R100 affects levels in the bottom quarter.

5. Adjust R119 for offset and R121 for gain so that with the step attenuator in the 0 dB Position the peak of the spectral line lies on the 30 dB line of the CRT and that successive step increases of the input attenuator move the spectral amplitude downward in 10 dB increments on the CRT. The accuracy required for any one step attenuator position is ±3 dB.

6. It will generally be necessary to repeat paragraphs 5-122.4 and 5-122.5 until the best possible accuracy is obtained.

7. Turn the power off and remove the Receiver Module and the Receiver Extender for the chassis. Remove the Test Cover from the Receiver Module and replace the module cover. Reinstall the Receiver Module into the system chassis.

## 5-123. CHECKOUT PROCEDURE

### 5-124. Introduction

5-125. This section provides a system checkout procedure. This procedure will help isolate system failures when used with the troubleshooting information in para 5-143.

### 5-126. Test Equipment Required

5-127. The test equipment listed in table 5-5 or its equivalent will be required to perform the checkout procedure.

Table 5-5. Test Equipment

| | |
|---|---|
| *RF Signal Generator | Motorola R-1201A |
| *RF Power Meter | Motorola S-1339A |
| *SINAD Meter | Motorola R-1013A |
| *Modulation Meter | Boonton 82AD |
| RF Power Source | 1 watt to 100 watts |

*An R2001 is suitable for use in place of these separate equipments.

### 5-128. Procedure

5-129. Power On

1. Check that the AC input power select card is in the 120 V position. Connect the Unit Under Test (UUT) to a 120 VAC line source with the front panel power switch off. Verify the presence of an AC indication on the front panel.

2. Set the power switch to the Standby Position. Verify the oven ready indicator is on.

3. Set the power switch to the on position. Verify that after a warm-up period a display is visible on the CRT.

5-130. Keyboard Check

1. Verify that each key has the proper effect by observing the Gen/Mon Mtr Display and entering the frequency 123.4567 MHz and the PL frequency 890. Check for proper cursor key operation.

2. Verify that the up and down display keys perform properly and that the LED at each display illuminates.

3. Verify that the up and down function keys perform properly and that the LED at each function illuminates.

4. Verify that the up and down modulation keys perform properly and that the LED at each modulation mode illuminates.

5-131. Nonvolatile Memory

1. Select some random combination of Display, Function, and Modulation Modes. Simultaneously depress both cursor keys and after a five second delay turn the system power OFF. Turn the system power back ON and verify that the same Display, Function, and Modulation Modes are present.

5-132. Modulation capability

1. Set the UUT to the Generate FM Mode and select the Gen/Mon Mtr Display. On the Gen/Mon Mtr Display enter a DPL code of 111. Select the Oscilloscope Display and connect the Mod Out Jack to the Vert In Jack. Set the code synthesizer to the Cont PL/DPL Mode. On the scope verify the presence of a DPL waveform whose amplitude is variable with the code synthesizer level control.

2. Move the Modulation switch from CONT to OFF and verify that a short burst of 133 Hz is output before the output stops.

3. Move the Modulation Switch to the BURST position. Verify that a 133 Hz tone is output as long as the switch is held in the BURST position.

4. Select the Tone A Continous Mode. Verify a Tone A output on the scope and at the speaker.

5. Select the Tone Remote Mode. Verify that when the Modulation Switch is moved from OFF to BURST that a single Tone Remote Access Sequence is generated.

6. Connect a microphone to the Mic Jack. Turn up the Ext Level Control and verify that speaking into the mike causes a modulation signal to be output as observed on the scope display.

5-133. Frequency Counter

1. Set the UUT to the Gen CW Mode with an output frequency of 35 MHz at a level of 0 dBm as displayed on the Gen/Mon Mtr display. Connect the RF In/Out Jack to the Counter In Jack of the UUT. Select the Frequency Counter Display and verify a frequency reading of 35 MHz.

2. Set the UUT to the Generate FM Mode and select the Gen/Mon Mtr Display. Turn the Code Synthesizer and Ext Modulation sources OFF. Select the Narrow Band Mode and adjust the 1 kHz Level Control for a 5 kHz FM deviation reading. Connect the Mod Out Jack to the Counter Input Jack of UUT. Select the Frequency Counter Display and verify a nominal frequency reading of 1 kHz.

5-134. DVM

1. Maintaining the same conditions as in paragraph 5-133.2, select the DVM Display and the AC Mode on the display. Verify a DVM reading of 0.707 vrms $\pm$0.04 vrms.

2. Select the DC Mode and verify a near zero volt DC reading.

5-135. Scope Mode

1. Set the UUT to the Scope AC display mode and connect the scope vertical input jack to the Mod Out Jack. Enable the internal 1 kHz modulation source. Verify the operation of each position of the vertical input range switch and the vertical vernier gain control.

2. With the same connection as in paragraph 5-135.1, verify the operation of each position of the Horizontal Control and the Horizontal timebase vernier.

3. With the Horizontal Control set to the External Mode, connect the External Horizontal jack to the Mod Out Jack. Verify a horizontal line whole length is variable with the Horizontal vernier.

4. Connect the Vert In jack to the Mod Out jack on the UUT. Set the vert and horizontal controls for a convenient display. Verify that a steady sync is obtained in either the Norm or Auto modes and that the point of triggering is adjustable with the level control. Remove the input signal and verify no horizontal sweep in the Norm mode and the presence of a horizontal sweep in theAuto mode.

5-136. Distortion/SINAD Meter

1. Set the UUT for the Generate FM Function, Narrow Band Mode, and the Tone Memory Display. On the Tone Table set Tone A for 2000.0 Hz.

2. Select the Gen/Mon Mtr Display and the Tone A Cont Modulation Mode. Turn the Ext Level and the 1 kHz Level Controls Off. Adjust the Code Synth Lvl Control for an FM deviation of 1.88 kHz as read on the CRT display.

CAUTION
CHANGES HAVE BEEN MADE ON THIS PAGE.
SEE ISSUE SHEET.
1/20/94

3. Without disturbing the Code Synth Lvl Control, turn the Code Synthesizer OFF. Turn ON the 1 kHz Level Control and adjust for an FM deviation of 7.5 kHz on the CRT display.

4. Connect the Mod Out Jack to the SINAD Input Jack on the UUT. Verify a SINAD reading greater than 25 dB.

5. Set the Code Synthesizer to the Continous Mode and verify a SINAD reading 12 dB ±1 dB.

5-137. Scan Mode

1. Set the UUT for the Gen/Mon Mtr display. Verify the proper operation of each of the RF Scan switch positions.

5-138. Generate Mode

1. Set the UUT for the Generate FM Mode at 200 MHz and select the Gen/Mon Mtr display. Verify an RF level output display on the CRT.

2. Connect the RF millivoltmeter with a 50 ohm termination to the RF In/Out Jack on the UUT. Set the RF step attenuator to the 0 dB position and adjust the Variable Level control to obtain a displayed output level of +13 dBm. Verify that the RF millivoltmeter reads +13 dBm ±2 dBm.

3. Repeat paragraph 5-138.2 except at a center frequency of 800 MHz.

4. Increase the RF Step Attenuator setting in 10 dB increments and verify that the displayed RF level decreases in 10 dB increments.

5. Set the Code Synthesizer Modulation switch and the Ext Level Control to their respective OFF positions. Select the Narrow Band mode and adjust the 1 kHz Level Control for a 5 kHz deviation reading on the CRT display. Verify a 1 kHz tone at the speaker output.

6. Connect the Modulation Meter to the RF In/Out Jack on the UUT. Set the Modulation Meter for a deviation display of 5 kHz ±250 Hz.*( If this is out of specification see note below) *

7. Select the Wide Band mode on the UUT and verify that the CRT displays a deviation of 20 kHz. Also verify that the Modulation Meter shows a peak deviation of 20 kHz ±1 kHz.

8. Select the Modulation Display on the UUT and verify a peak-to-peak modulation display of 40 kHz ±2 kHz.

9. Select the Generate CW Function and verify that no modulation is present on the CRT.

10. Set the UUT for the Generate AM Function, the Gen/Mon Mtr Display, and adjust for an RF output level of 0 dBm. Adjust the 1 kHz Level Control for a 50% AM reading on the CRT. Verify that the Modulation Meter reads 50% ±10% AM.

11. Select the Modulation Display and verify a low distortion 1 kHz sinewave.

12. Set the UUT for the Generate SSB/DSBSC Function and verify a low distortion 1 kHz sinewave on the CRT.

13. Set the UUT for the Generate SWP 1-10 MHz Function and the Scope DC Display. Verify a horizontal trace and a center frequency display on the CRT.

14. Set the UUT for the Generate SWP 0.01 - 1 MHz Function and verify the same results as paragraph 5-138.13.

* - Set R2001C 1 kHz level control for a + and - 5.00 kHz deviation indication on
* R-2001C screen. Adjust A5 R354 for 5.00 kHz deviation indication on
Modulation Meter (HP 8901A). A5 R354 is located on left side, upper
right hand corner of A5 box. Adjust through hole in A5 cover. Set A4
Receiver box up on extender to reach A5 R354. J. Morton
1/21/94

A5 R354

CHANGES HAVE BEEN MADE ON THIS PAGE. SEE ISSUE SHEET. 1/23/94

5-139. Power Monitor Mode

1. Set the UUT to the Power Monitor Mode. Set the RF Step Attenuator to the 30 dB position, and select the Gen/Mon Mtr Display. Connect the RF power source to the RF In/Out Jack. Key the power source and verify a correct power reading on the CRT display. Unkey the power source.
2. Set the UUT to the Monitor Function and verify that the RF Step Attenuator is in the 30 dB position. Key the RF power source and verify the presence of an audible alarm and a warning display on the CRT. Unkey the power source.

5-140. Monitor Mode

1. Set the UUT to the Monitor FM Function. Set the Squelch Control to the OFF position and verify the presence of a Sig Lvl indication and noise at the speaker. Turn the Squelch Control full on and verify the absence of a Sig Lvl indication and noise at the speaker.
2. Repeat paragraph 5-140.1 except for the AM function.
3. Repeat paragraph 5-140.1 except for the SSB/DSBSC Function and enable the BFO. After the test turn the BFO off.
4. Select the Narrow Band FM Monitor Function at 300 MHz and set the RF Step Attenuator to the 0 dB position. Connect the RF Signal Generator to the RF In/Out Jack and the SINAD Meter to the Demod Out Jack. Set the RF Signal Generator for a center frequency of 300 MHz and for 3 kHz FM at a 1 kHz rate. Adjust the RF output level from the Signal Generator for a 10 dB reading on the SINAD Meter. Verify that the Signal Generator's level is less than −103 dBm (1.5 $\mu$Vrms).
5. Calibrate the RF Signal generator for 3 kHz FM at 1 kHz rate using the Modulation Meter. Set the Generator for a nominal output level of −60 dBm and connect it to the RF In/Out Jack of the UUT. Select the Gen/Mon Mtr Display and verify a monitor deviation reading of 3 kHz ±150 Hz.
6. Calibrate the RF Signal Generator for 50 kHz FM at a 1 kHz rate. Select the Wide Band Mode on the UUT and verify a reading of 50 kHz ±2.5 kHz on the CRT deviation display.
7. Calibrate the RF Signal generator for 30 % AM at a 1 kHz rate. Set the Generator for a nominal output level of −60 dBm and connect it to the RF In/Out Jack of the UUT. Select the Monitor AM Function and the Narrow Band Mode. Verify a monitor AM reading of 30% ±5%.
8. Monitor the % AM Displayed on the CRT while increasing the RF level out of the Signal Generator. Verify that the IF Overload Warning occurs before the displayed AM exceeds a reading of 30% ±5%. * *
9. Select the Modulation Display on the UUT and verify the presence of the received modulation signal.
10. Select the Gen/Mon Mtr Display and the Wide Band Mode on the UUT. Vary the center frequency on either the UUT or the Signal Generator and verify that the Frequency Error Display properly represents the difference between the UUT's Center frequency and the Signal Generator's center frequency.
11. Select the IF Display on the UUT and verify the presence of an IF envelope on the CRT.

* Adjust A4R57 in Receiver box to set point where IF Overload Warning occurs.

* Typical RF input level for IF Overload Warning Indication is around - 40 dbm.

J. Morton 11/9/90

JD 5/15/92

5-141. . Spectrum Analyzer

1. Set the UUT for the Monitor Function at 300 MHz the Spectrum Analyzer Display, and 0 dB input attenuation. Connect the Signal Generator to the RF In/Out Jack on the UUT. Verify a spectral amplitude of −30 dBm ±5 dB on the CRT display. Increase the RF Step Attenuator in 10 dB increments verifying that the spectral amplitude decreases by 10 dB ±3 dB with each step.

2. Verify the operation of the Dispersion Control.

5-142. Duplex Generator

1. Select the Duplex Generator Display and the Monitor Function at a frequency of 100 MHz. Enable the 45 MHz offset frequency. For an Image Low switch position verify that a displayed duplex frequency of 55 MHz can be obtained. Set the Image Switch to the HIGH position and verify a duplex frequency display of 145 MHz.

2. Enable the 0 - 10 MHz offset frequency and verify that displayed duplex frequencies from 100 MHz to 110 MHz can be obtained.

3. Set the UUT to the Generate Function with the Duplex Generator Display. With the Code Synthesizer and the External Modulation sources OFF, adjust the 1 kHz Level Control for a 20 kHz FM deviation reading on the CRT. Select the Monitor Function and adjust the offset frequency for a duplex output of 100 MHz. Connect the Duplex Output Jack to the RF In/Out Jack and verify a 20 kHz ± 1 kHz FM deviation reading on the CRT.

**5-143. System Troubleshooting**

5-144. A troubleshooting procedure is outlined in Table 5-6. Because of the complexity of the system the table covers only the major failures and provides only a guide to the most probable failed module. When using the table it is important to use the checkout procedure at paragraph 5-123 to determine the fault. The troubleshooting table assumes that all tests prior to the failure point have been successfully completed and thus the applicable circuits are okay.

5-145. A list of the system test points and their functions are provided in Table 5-7. Test points are identified on the block diagrams for the Theory of Operation discussion of paragraph 5-16 and for the Module Descriptions to aid in troubleshooting.

Table 5-6. System Troubleshooting

| Test Paragraph | Fault | Troubleshooting Procedure |
|---|---|---|
| 5-129 | No AC indication | 1. Check AC linecord and line fuse.<br>2. If system powers up normally when on, Replace AC LED. |
| 5-129 | No Oven Ready indication | 1. Check for approximately +15 VDC at E13 of the A13 module. If not present replace the Low Voltage Power Supply (A1).<br>2. Check E11 of A13 for +9 VDC and E12 for approximately +7.5 VDC. If E11 is okay and E12 is 0 VDC, replace the LED. If the +9 VDC is not present on E11 replace A13. |

Table 5-6. System Troubleshooting (Cont)

| Test Paragraph | Fault | Troubleshooting Procedure |
|---|---|---|
| 5-129 | System won't turn on | 1. Disconnect the high voltage supply from the low voltage supply at A10P1. Check for nominal voltages of 15 VDC at pin 3 of U2 on the low voltage supply and for +12 VDC at pin 8. If either voltage is not present replace the low voltage supply (A1).<br>2. Reconnect the low voltage/high voltage interface and check for a nominal +9 VDC on the collectors of Q3 and Q4. (The actual signal on the collectors is a 0 VDC to +18 VDC square wave).<br>If 9 volts is not present replace the high voltage supply (A10).<br>3. If items 1 and 2 check okay replace the low voltage supply (A1). |
| 5-129 | System turns on, but no display on the CRT for any display mode | 1. Check for presence of high voltage by disconnecting the CRT anode lead and arcing it to the chassis. If no arc, replace the high voltage supply.<br>2. If the high voltage supply is okay, replace the CRT. |
| 5-130 | More than one key is inoperative or has the wrong effect | 1. Replace the Processor Module (A9). |
| 5-130 | Only one key is inoperative | 1. Replace the defective key switch. |
| 5-131 | Any part of the nonvolatile memory fails to remember | **WARNING**<br>Lithium Battery<br>Do not mutilate or disassemble the battery cell. The lithium metal is a very active material that burns in the presence of water or high humidity. Do not put the battery in fire, attempt to charge, heat above 100°C, or solder directly to the cell. Do not overdischarge the cell to a reverse voltage greater than 3 volts. The battery may burst and burn or release hazardous materials.<br>1. Troubleshooting Instructions:<br>A. Turn system power switch off and disconnect the unit from the primary power source.<br>B. Remove the Processor Module (A9) from the system and place on a non-conductive surface.<br>C. With a voltmeter measure the DC voltage across the lithium battery in the lower left corner of the board. |

Table 5-6. System Troubleshooting (Cont)

| Test Paragraph | Fault | Troubleshooting Procedure |
|---|---|---|
| | | D. If the battery voltage is less than 2.4 volts, the cell is discharged and should be replaced. If the battery is okay, replace the entire Processor Module (A9).<br>E. If a new battery is needed, obtain a new cell (P/N60-80396A0) from Motorola. Replace the battery using the procedure in Part 2.<br><br>**CAUTION**<br>Do not substitute another type lithium battery as a replacement. The specified battery was chosen with safety as a major consideration. Other lithium battery types may present a potential hazard when used in this system.<br><br>2. Replacement Instructions:<br>A. Turn system power switch off and disconnect the unit from the primary power source.<br>B. Remove the Processor Module (A9) from the system and place on a nonconductive surface.<br>C. Cut each of the two wires connecting the battery to the circuit board near each battery end.<br>D. Remove the battery from the hold-down clip.<br>E. Remove the new battery from its shipping container and put the old battery into the shipping container. Dispose of the battery as per Part 3.<br>F. With a 40-watt or lower watt soldering iron remove the old battery leads from the board.<br>G. Using care not to short the battery leads to each other or to the battery case, install the battery into the hold-down clip with the negative lead nearest the left edge of the card (circuit board connector edge toward you).<br>H. Solder the leads from the new battery into the printed wiring board at the points where the old leads were removed from.<br>I. Trim the lead ends and reinstall the module into the system. |

Table 5-6. System Troubleshooting (Cont)

| Test Paragraph | Fault | Troubleshooting Procedure |
|---|---|---|
| | | 3. Disposal Instructions<br>A. Do not dispose of the lithium battery by placing it in the everyday trash. Lithium batteries are classified as hazardous material and must be disposed of accordingly.<br>B. Consult State and Local Codes for the appropriate procedure to be used for disposal.<br>C. Motorola will dispose of the battery for you if you send it in the shipping container and by the same method that the new battery came to you to:<br>Motorola, Inc.<br>Return Goods Department<br>1313 East Algonquin Road<br>Schaumburg, Ill 60196 |
| 5-132 | No DPL (modulation) signal on CRT | 1. Check TP1 of the Audio Synthesizer for the presence of the DPL signal. If not present replace the Audio Synthesizer module.<br>2. Check for the DPL signal on pin 64 of the Audio Synthesizer. If not present replace the IEEE interface module (A8), or check for the presence of the jumpers on J8 for the standard unit.<br>3. Check for the DPL signal at TP6 of the Audio Synthesizer. If not present replace the Audio Synthesizer (A6).<br>4. Check for the DPL signal at TP4 of the Scope Amplifier module (A2). If not present replace the Scope/DVM control module (A3).<br>5. If signal switching is okay to the Scope Amplifier module proceed to the scope troubleshooting information. |
| 5-132 | No external modulation on the CRT | 1. Check for modulation signal at TP7 of the Audio Synthesizer module (A6). If not present replace the Audio Synthesizer module. |

Table 5-6. System Troubleshooting (Cont)

| Test Paragraph | Fault | Troubleshooting Procedure |
|---|---|---|
| | | 2. Check for the modulation signal on pin 66 of the Audio Synthesizer. If not present replace the IEEE Interface module (A8), or check for the presence of the modulation jumpers on J8 for the standard unit.<br>3. Continue troubleshooting at step 3 of the "no DPL signal on the CRT": |
| 5-133 | Frequency Counter inoperative | 1. Check for presence of a 1 kHz singal at TP9 of the Audio Synthesizer (A6). If not present check for the 10 MHz signal from the Frequency Standard module (A13) to the RF Synthesizer (A5). If present replace the RF Synthesizer. If not present replace the Frequency Standard module.<br>2. If the 1 kHz signal is present check for the presence of the signal to be counted at pins 61 and 63 of the processor I/O module (A7). If not present replace the Front Panel Interface Module (A12).<br>3. If signal is okay up to the Processor I/O module replace the Processor I/O module. |
| 5-133 | DVM AC mode is inoperative | 1. Check for DVM signal at pin 22 of Front Panel Interface module (A12). If not present replace the Front Panel Interface module.<br>2. Check for short bursts of the DVM AC signal at TP2 of the Scope/DVM Control module (A3). If signal is not present at TP2 replace the Scope/DVM Control module.<br>3. If the signal is okay to TP2 of A3, replace the Processor I/O module (A7). |
| 5-134 | DVM DC mode is inoperative | 1. Check for the DC input level attenuated by factors of 10 to less than 1 volt at pin 22 of the Front Panel Interface module (A12). If not present of if greater than 1 volt, replace the Front Panel Interface module.<br>2. Check for same voltage at TP2 of A3. If signal not present, replace A3.<br>3. If signal is present at TP2, replace Processor I/O module A7. |

Table 5-6. System Troubleshooting (Cont)

| Test Paragraph | Fault | Troubleshooting Procedure |
|---|---|---|
| 5-135 | No horizontal sweep<br>**See "CAUTION" note on page 4-19** | 1. Check for a voltage level between −2.0 VDC and +2.0 VDC at TP4 of the Scope Amplifier module (A2). If the voltage cannot be brought within range with either the vertical range attenuator or the vertical position control replace the Front Panel Interface module (A12).<br>2. If the voltage at TP4 is okay replace the Scope Amplifier module (A2). |
| 5-135 | No vertical display | 1. Check for the input signal at TP4 of the Scope Amplifier Module (A2). If not present replace the Front Panel Interface Module (A12)<br>2. If signal is okay at TP4 replace the Scope Amplifier Module (A2). |
| 5-135 | No vertical snyc | 1. Check for the presence of sync pulses at pin 12 of the Scope/DVM Control module (A3) and for a nominal zero volt sync present level at pin 76. If either signal is not present replace the Scope/DVM Control module.<br>2. If sync pulse and the syn present lines are okay replace the Scope Amplifier Module (A2). |
| 5-136 | Distortion/SINAD meter inoperative | 1. If the DVM mode checks okay replace the Scope/ DVM Control module (A3).<br>2. If the DVM mode does not check okay go to the troubleshooting list for DVM AC inoperative. |
| 5-138 | No generate output | 1. Remove the RF cable between the RF Synthesizer (A5) and the RF Input module (A11). Check for a nominal −10 dBm level at the Synthesizer output. If no output replace the RF Synthesizer.<br>2. If the Synthesizer output is okay replace the RF input module (A11). |
| 5-138 | No Frequency Modulation | 1. Check for modulation signal at pin 56 of the RF Synthesizer (A5). If the signal is okay replace the RF Synthesizer.<br>2. If the modulation signal is not present proceed to the troubleshooting list under "no DPL (modulation) signal on CRT". |

Table 5-6. System Troubleshooting (Cont)

| Test Paragraph | Fault | Troubleshooting Procedure |
|---|---|---|
| 5-139 | Internal wattmeter in error | 1. Replace RF input module (A11). |
| 5-140 | No monitor function | 1. Apply a 10.7 MHz modulated carrier to the RF input. Check for normal receiver operation except reduced sensitivity. If receiver is not working replace the Receiver module (A4).<br>2. If the receiver checks okay and the generate function is okay, replace the RF Input module (A11). |
| 5-140 | Monitor frequency error display is missing | 1. Go to the troubleshooting list under "frequency counter inoperative". |
| 5-140 | Monitor frequency error is in error | 1. Check for presence of IF signal at pin 91 of the Scope/DVM Control module (A3). If not present replace the Receiver module (A4).<br>2. If the IF signal is present replace the Scope/DVM Control module. |
| 5-141 | No spectrum analyzer sweep | 1. Check pin 6 of the RF Synthesizer module (A5) for a 50 Hz square wave. If not present replace the RF Synthesizer module.<br>2. If 50 Hz signal is present replace the Scope/DVM Control module (A3). |
| 5-141 | Spectrum display is in error | 1. Replace the Receiver module (A4). |
| 5-142 | No duplex output | 1. Replace the RF Input module (A11). |

Table 5-7. Test Point Identification

All test points are located near the top edge of the card and counted from left to right when facing the component side of the card.

| Module | Test Point No. | Signal Name |
|---|---|---|
| A1 | | |
| Low Voltage | | |
| Power Supply | | |
| A1A1 | 101 | Pulse Width Mod Out |
| | 102 | Pulse Width Mod Dr |
| | 103 | HV Source Voltage |
| A1A2 | 201 | Ground |
| | 202 | +5V FB |
| | 203 | −5V |
| | 204 | +12V |
| | 205 | −12V |
| | 206 | +33V |
| | 207 | +110V |
| | 208 | −110V |
| A1A3 | | |
| Control Board | 301 | +8V |
| | 302 | PWM Dr |
| | 303 | Error Voltage |
| | 304 | H.V. Bias Supply Voltage |
| | 305 | Sawtooth Voltage |
| | 306 | Chopper DR A |
| | 307 | Chopper DR B |
| A1A4 | | |
| Relay Assembly | 401 | Batt Chg |
| | 402 | Frequency Std Sup Voltage |
| | 403 | Relay +12V |
| | 404 | Dc Bus |
| A2 | 1 | Int Horiz Input |
| Scope Amplifier | 2 | Horizontal Deflection Plate |
| | 3 | $\overline{\text{Horizontal Deflection Plate}}$ |
| | 4 | Vertical Drive |
| | 5 | Focus TV |
| | 6 | Vertical Deflection Plate |
| | 7 | $\overline{\text{Vertical Deflection Plate}}$ |
| | 8 | CRT Z-Axis |

Table 5-7. Test Point Identification (Cont)

| Module | Test Point No. | Signal Name |
|---|---|---|
| | 9 | Intensity TV |
| | 10 | Time Base Output |
| A3 | 1 | Vertical Character Sync |
| Scope/DVM Control | 2 | Ext DVM to A/D |
| | 3 | +15V |
| | 4 | Positive Peak Detector |
| | 5 | Int. DVM to A/D |
| | 6 | Negative Peak Detector |
| | 7 | Carrier + MOD Level |
| | 8 | Character Gen. Reset |
| | 9 | GND |
| | 10 | GND |
| | 11 | +8V |
| | 12 | −8V |
| A6 | 1 | Synth DPL Audio |
| Audio Synthesizer | 2 | DPL Clock |
| | 3 | Unfiltered DPL |
| | 4 | Synth. D/A Output |
| | 5 | Ground |
| | 6 | Composite Modulation Audio |
| | 7 | Composite External Mod. Audio |
| | 8 | Synthesizer Clock 104, 857.6 Hz |
| | 9 | 1 kHz Modulation Source |
| A7 | 1 | A/D Input |
| Processor I/O | 2 | Unfiltered 10.245 MHz T.V. |
| | 3 | DVM/Freq. Counter Select |
| | 4 | Frequency Counter Input |
| | 5 | Not Used |
| A9 | 1 | Ground |
| Processor | 2 | Dot Clock |
| | 3 | Character Row Clock |
| | 4 | Character Clock |
| | 5 | Enable |
| | 6 | Character Line Clock |
| | 7 | R/W Select |
| | 8 | Char. Gen/Processor Select |
| A12 | 1 | Attenuator Buffer Output |
| Front Panel | | |
| Interface | | |

# SECTION 6
# SYSTEM INTERCONNECT AND PARTS LISTS

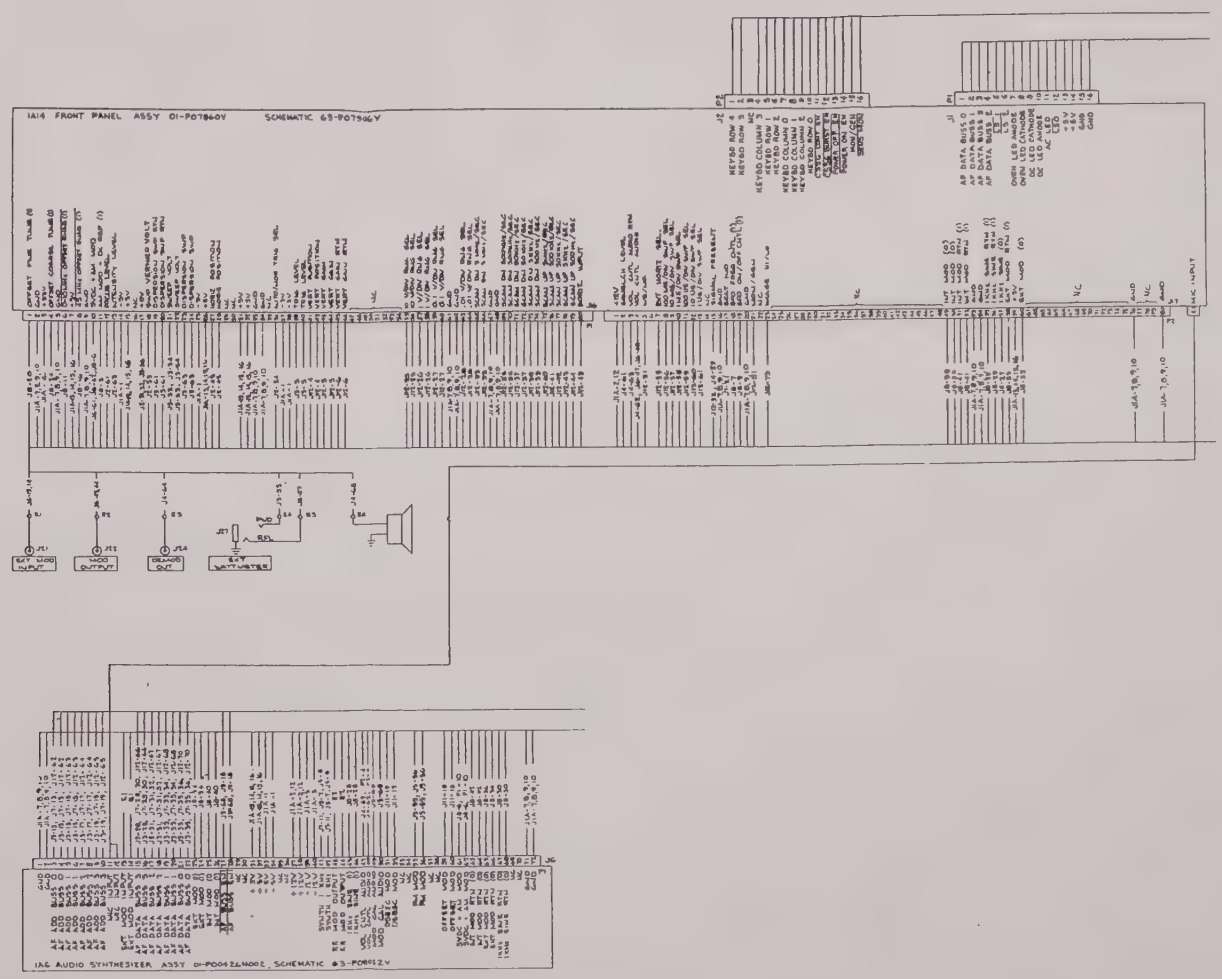



Figure 6-1. Communications System Analyzer Interconnection Diagram (Sheet 1 of 4)

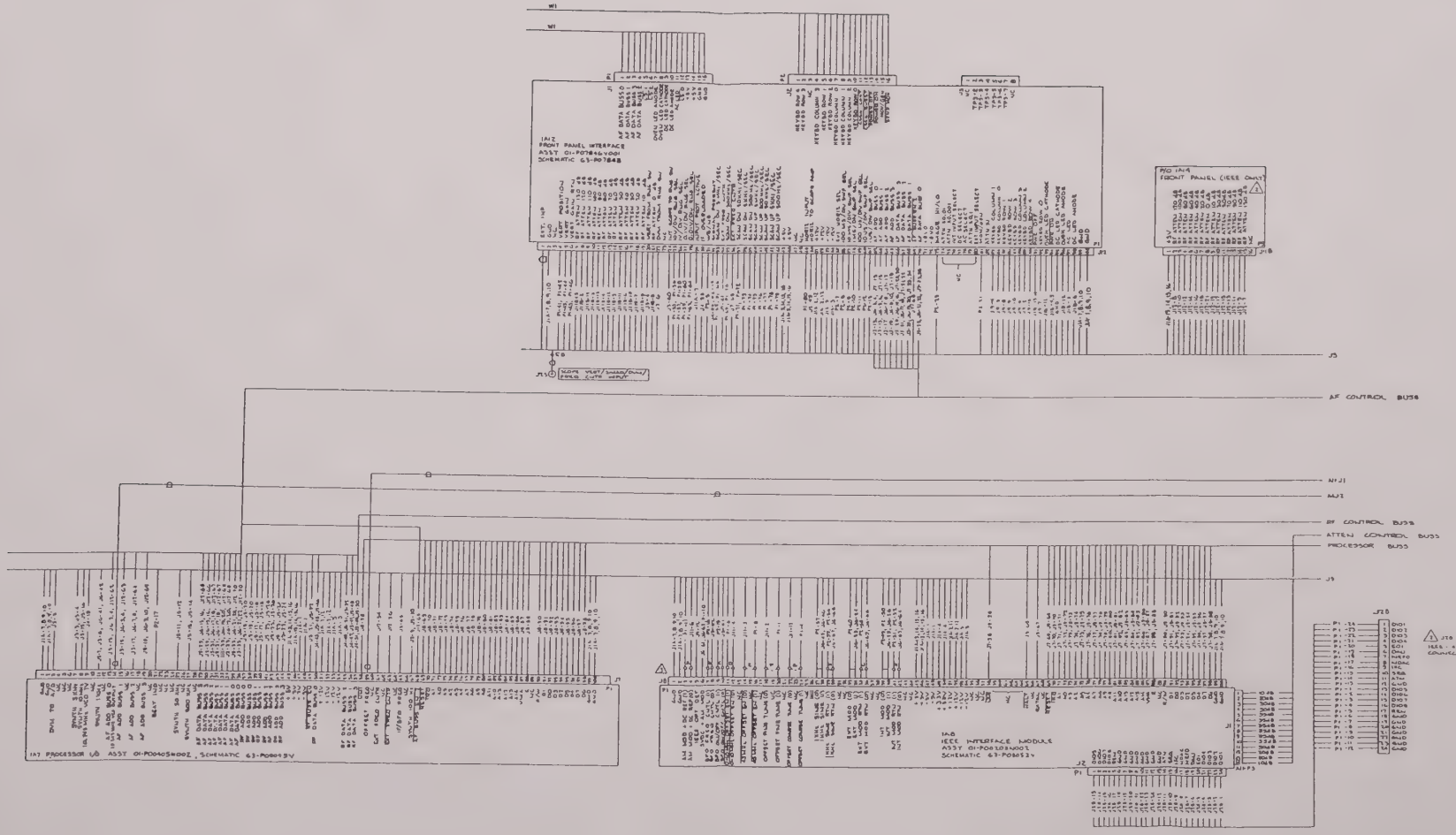



Figure 6-1. Communications System Analyzer Interconnection Diagram (Sheet 2 of 4)

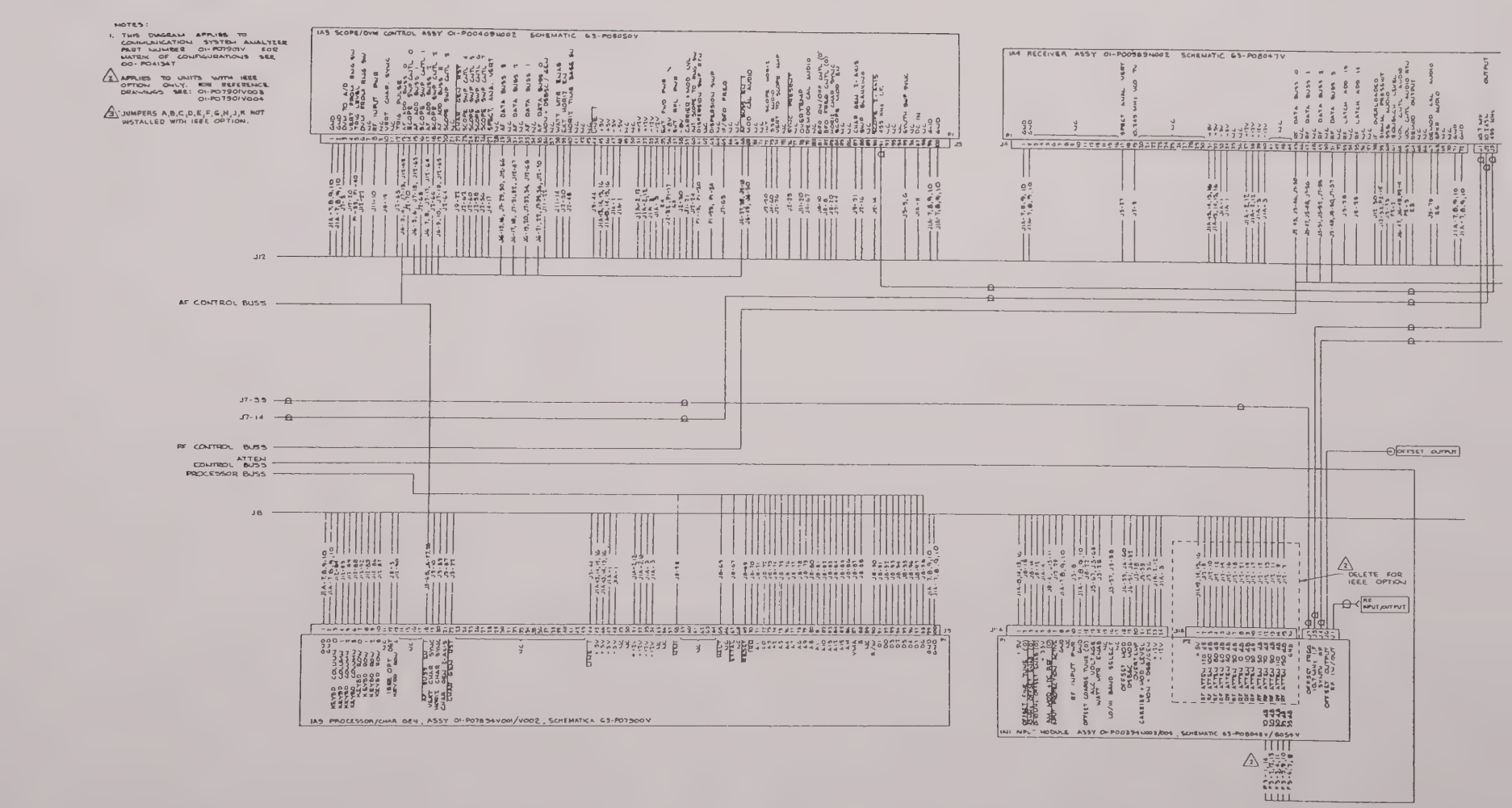

NOTES:
1. THIS DIAGRAM APPLIES TO COMMUNICATION SYSTEM ANALYZER PART NUMBER 01-P07901V. FOR MATRIX OF CONFIGURATIONS SEE 00-P04134T
1 APPLIES TO UNITS WITH IEEE OPTION ONLY. FOR REFERENCE DRAWINGS SEE: 01-P07901V003 01-P07901V004
2 JUMPERS A,B,C,D,E,F,G,H,J,K NOT INSTALLED WITH IEEE OPTION.
1A9 SCOPE/DVM CONTROL ASSY 01-P00409N002 SCHEMATIC 63-P08050Y
1A4 RECEIVER ASSY 01-P00583N002 SCHEMATIC 63-P08047V
1A9 PROCESSOR/CHAR GEN. ASSY 01-P07834V001/V002, SCHEMATICS 63-P07300V
1A11 RF I/O MODULE ASSY 01-P00394N003/004, SCHEMATIC 63-P08048V/80547V
J12
AF CONTROL BUSS
J7-39
J7-14
RF CONTROL BUSS
ATTEN CONTROL BUSS
PROCESSOR BUSS
J8
OFFSET OUTPUT
DELETE FOR IEEE OPTION
RF INPUT/OUTPUT

Figure 6-1. Communications System Analyzer Interconnection Diagram (Sheet 3 of 4)

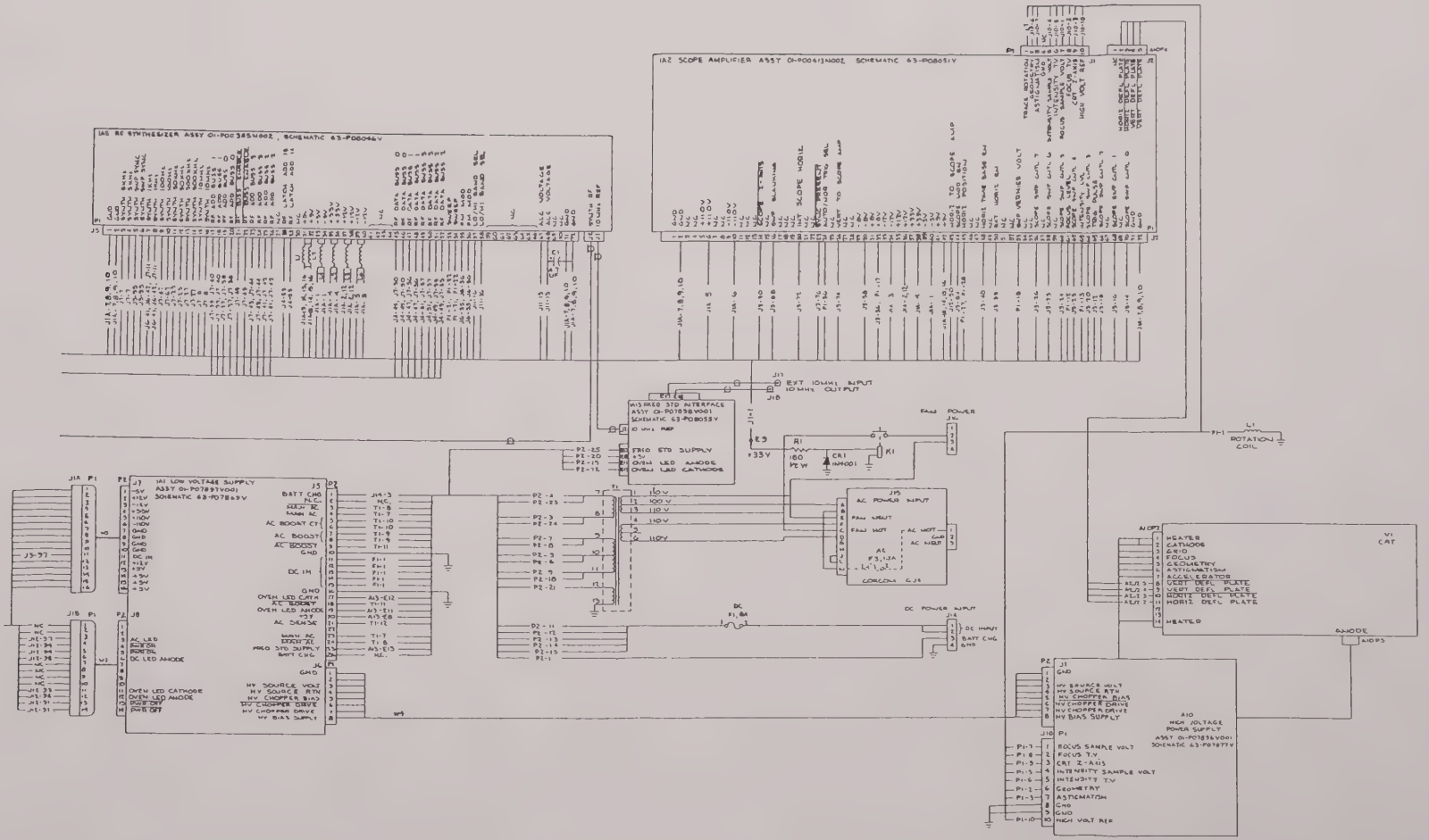


Figure 6-1. Communications System Analyzer Interconnection Diagram (Sheet 4 of 4)

| Find No. | Qty. Req. | Part No. | Nomenclature | Part Value |
|---|---|---|---|---|
| 001 | 1 | 84-80396A77 | MOTHERBOARD | |
| 002 | AR | SN63WRP3 | SOLDER | |
| 003 | AR | 11-14167A01 | INK | BLACK |
| 004 | 1 | 09-80331A96 | SOCKET,SOLDER DIP | 14 PIN |
| 005 | 2 | 09-80331A97 | SOCKET,SOLDER DIP | 16 PIN |
| 006 | 1 | 09-80331A98 | SOCKET,SOLDER DIP | 24 PIN |
| 007 | AR | | WIRE | #24 WHT |
| C 001 | 1 | 23D83441B18 | CAPACITOR | 4.7UF-20-50 |
| J 003 | 1 | 09-80396A93 | CONNECTOR | |
| J 004 | 1 | 09-80396A92 | CONNECTOR | |
| J 005 | 1 | 09-80396A92 | CONNECTOR | |
| J 006 | 1 | 09-80396A92 | CONNECTOR | |
| J 007 | 1 | 09-80396A93 | CONNECTOR | |
| J 008 | 1 | 09-80396A93 | CONNECTOR | |
| J 009 | 1 | 09-80396A93 | CONNECTOR | |
| J 012 | 1 | 09-80396A93 | CONNECTOR | |
| L 001 | 1 | 25-83127G01 | CHOKE,AUDIO | |
| L 002 | 1 | 25-83127G01 | CHOKE,AUDIO | |
| L 003 | 1 | 25-83127G01 | CHOKE,AUDIO | |
| L 004 | 1 | 24-80369A34 | COIL | 47UH |
| L 005 | 1 | 24-80348A83 | COIL | 470UH |
| L 006 | 1 | 24-80369A35 | COIL | 100UH |

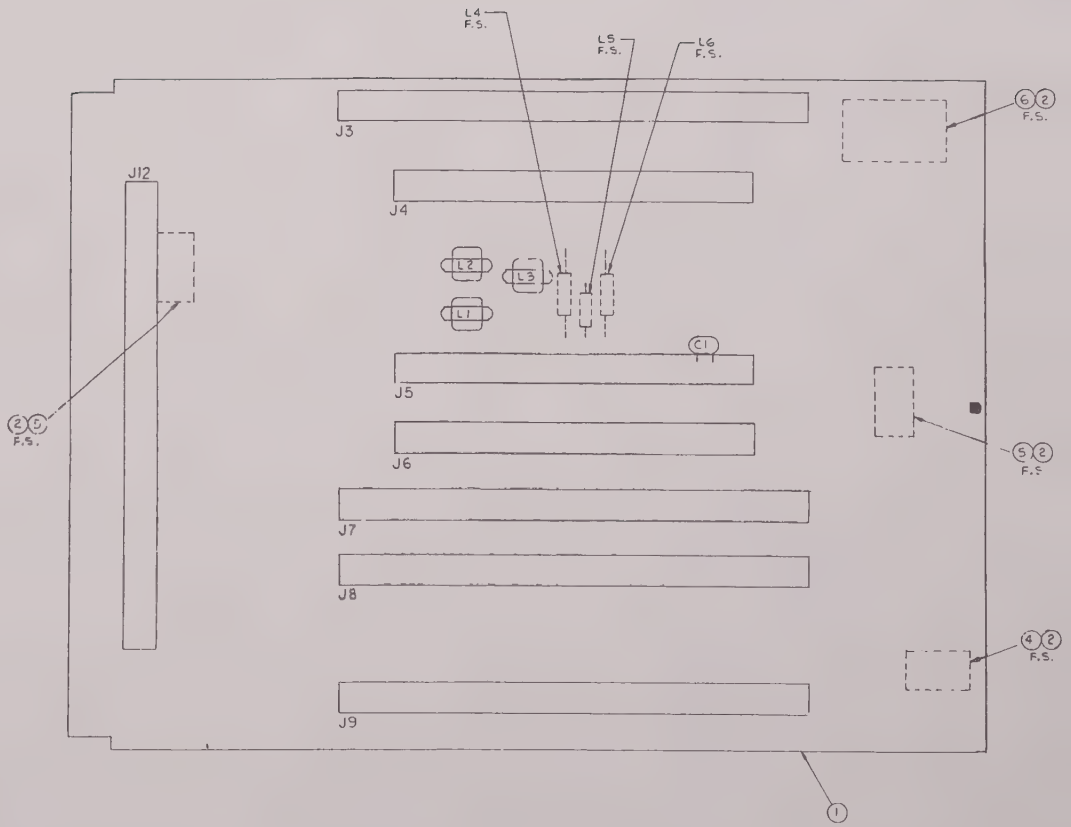
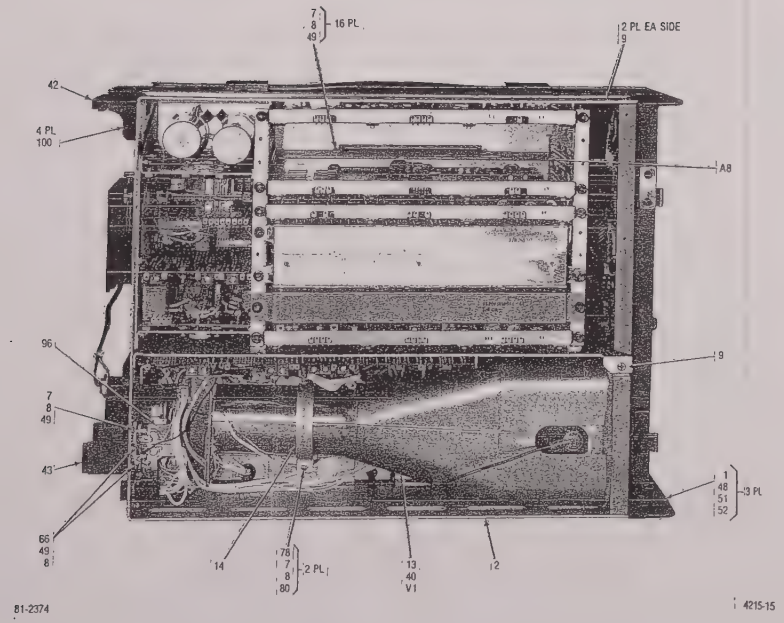


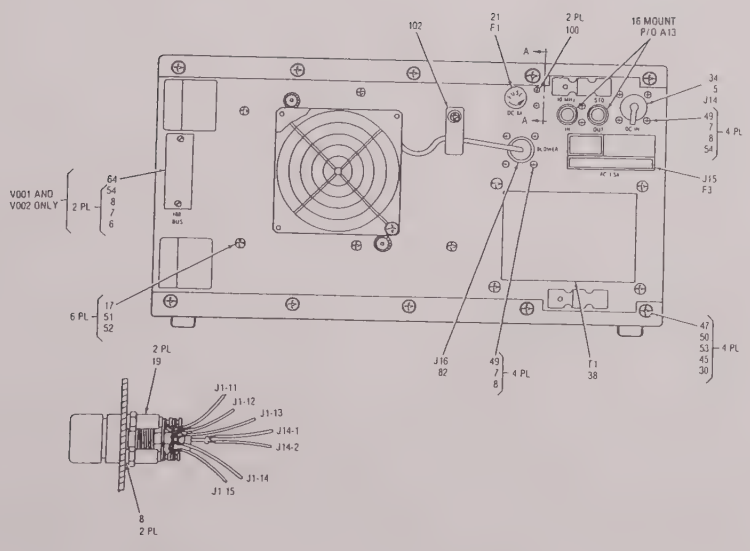

Figure 6-2. Motherboard Assembly RTL-4089A
Parts Location Diagram



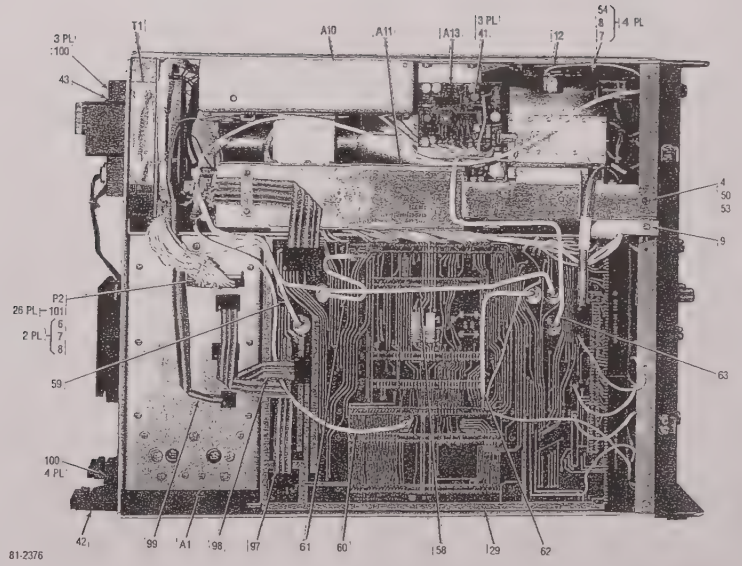

Communications System Analyzer, Top View

| Find No. | Qty. Req. | Part No. | Nomenclature | Part Value |
|---|---|---|---|---|
| 002 | 1 | 15-80331A62 | COVER,SYSTEM,TOP | |
| 003 | 1 | 15-80396A90 | COVER,SYSTEM,BOTTOM | |
| 004 | 1 | 55-80335A58 | HANDLE, BAIL | |
| 005 | 1 | 55-80335A73 | HANDLE, BAIL | |
| 009 | 1 | MS24693-S24 | SCREW,FL HD | .138-32X 250 |
| 010 | 1 | 55-80396A80 | HANDLE,MOLDED | |
| 012 | 2 | 15-80331A65 | COVER,HANDLE | |
| 016 | 1 | 1-80304A52 | FRONT COVER ASSY | |
| 030 | 26 | 03-P07961V009 | SCREW,PH ASSEMBLED | WA6-32X.312 |
| 042 | 2 | MS24693-C49 | SCREW | 8-32X.438 |
| 045 | 1 | 58-84300A98 | CONN,ADAPTER | N-BNC |
| 049 | AR | 11D84308A11 | PAINT | SHADOWBRONZE |
| 060 | 1 | 33-P07987V001 | LABEL,PATENT | |
| 061 | 1 | 33-80310A66 | LABEL,IDENTIFICATION | |
| A 002 | 1 | RTC-4007B | SCOPE HORZ/VERT AMPLS | |
| A 003 | 1 | RTC-4024A | SCOPE/OVM CONTROL BD | |
| A004 | 1 | RTL-1002B | RECEIVER ASSY A4 | |
| A 005 | 1 | RTC-1001B | SYNTHESIZER A5 | |
| A006 | 1 | RTC-4011B | AUDIO SYNTHESIZER A6 | |
| A 007 | 1 | RTC-4025A | PROCESSOR I/O A7 | |
| A 008 | 1 | 84-P01315V001 | INTERCONNECTION A8 | |
| A 009 | 1 | RTC-4026A | MICRO PROC CHAR GEN A | |

Figure 6-3. Communications System Analyzer
Parts Location Diagram
(Sheet 2 of 3)




Communications System Analyzer, Rear Panel




Communications System Analyzer, Bottom View

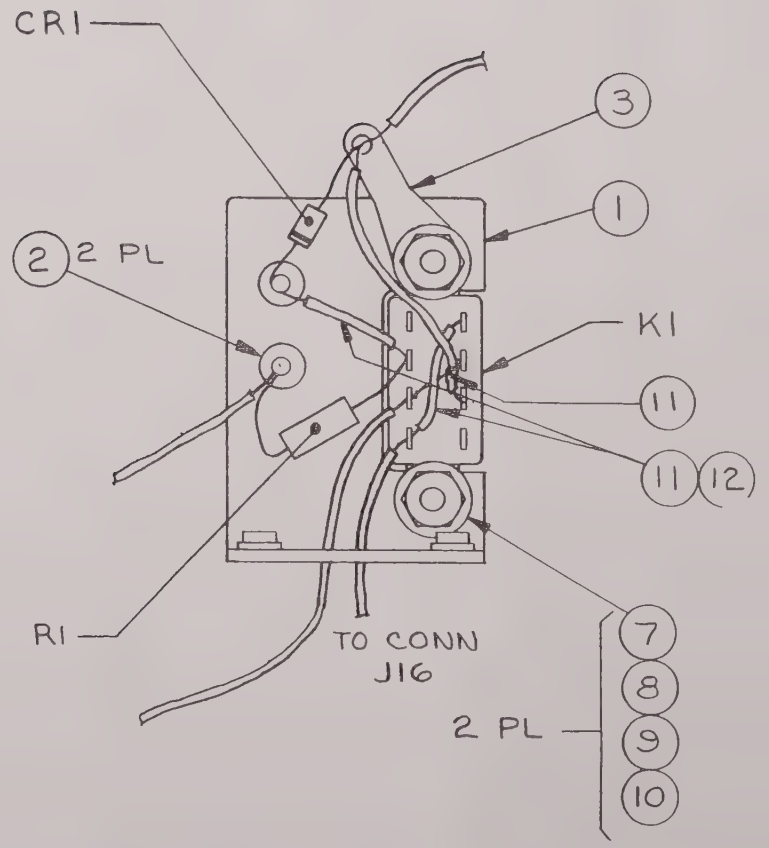
Figure 6-3. Communications System Analyzer Parts Location Diagram (Sheet 1 of 3)

| Find No. | Qty. Req. | Part No. | Nomenclature | Part Value |
|---|---|---|---|---|
| 001 | 1 | 1-80305A75 | FRONT PANEL ASSEMBLY | |
| 002 | 1 | 27-P07884V001 | CHASSIS, SYSTEM | |
| 003 | 2 | MS51957-23 | SCREW,PH, CRES | 4-40X1.5 |
| 004 | 2 | MS35206-226 | SCREW, PH | 6-32X.250 |
| 005 | 3 | 66602-1 | CONTACT PIN | |
| 006 | 11 | 03-139581 | SCREW, PH | 4-40X.312 |
| 007 | 45 | 04-7607 | WASHER, FLAT | NO. 4 |
| 008 | 49 | 04-114583 | WASHER, LOCK | NO. 4 |
| 009 | 5 | MS24693-S24 | SCREW, FLHO | 6-32X1/4 |
| 010 | AR | | WIRE | 22 WHT |
| 011 | AR | SN63WRMAP3 | SOLDER | |
| 012 | 1 | 50D83205B03 | SPEAKER | |
| 013 | 1 | 26-P07967V001 | SHIELD, CRT | |
| 014 | 1 | 42-80335A49 | BRACKET, CRT SHIELD | |
| 017 | 6 | 03-80396A94 | SCREW, PH BLACK | .1380-32X.437 |
| 018 | AR | MS3367-4-9 | STRAP | NATURAL |
| 019 | 2 | SE205001S | TERMINAL, INSULATED | |
| 020 | 2 | MS35206-216 | SCREW, PH | .1120-40X.438 |
| 021 | 1 | 9-80331A93 | FUSEHOLDER | |
| 022 | AR | 3738 | ADHESIVE, CARTRIDGE | .45X120 |
| 029 | 1 | RTL-4108A | MOTHERBOARD ASSEMBLY | |
| 030 | 4 | MS35649-262 | NUT, HEX | .1380-32 |
| 034 | 1 | 38-80370A52 | SEALING CAP | |
| 035 | 1 | 36-80335A88 | KNOB, SPECIAL | |
| 036 | 1 | 58-80396A79 | COUPLING, FLEXIBLE | |
| 037 | 1 | 47-80331A45 | SHAFT, EXTENSION | |
| 038 | 1 | 15-P07880V001 | COVER, TRANSFORMER | |
| 040 | 1 | 75-80335A51 | ISOLATOR, CRT, BOTTOM | |
| 041 | 3 | MS24693-268 | SCREW, FH BLACK | 6-32X.375 |
| 042 | 2 | 42-80396A89 | FOOT, BATTERY HOLDER | |
| 043 | 2 | 42-80331A47 | FOOT, BATTERY HOLDER, L | |
| 045 | 4 | 12SW50815 | WASHER, SHOULDER, NYLON | |
| 047 | 4 | MS35206-235 | SCREW | .1380-32X1.250 |
| 048 | 5 | 03-P07961V009 | SCREW, PH ASSEMBLY | 6-32X.312 |
| 049 | 28 | MS35206-215 | SCREW | 4-40X.375 |
| 050 | 8 | MS27183-5 | WASHER, FLAT | NO. 6 |
| 051 | 6 | 4-80335A99 | WASHER, FLAT BLACK | NO. 6 |
| 052 | 6 | 4-80346A64 | WASHER, LOCK BLACK | NO. 6 |
| 053 | 8 | MS35338-41 | WASHER, LOCK | NO. 6 |
| 054 | 10 | MS35649-242 | NUT, HEX | 4-40 |
| 057 | 2 | 54-P00301N001 | PLATE, THREADED | |
| 058 | 1 | 1-80304A46 | CABLE ASSEMBLY A11/A4 | 10.7 MHz, IF |
| 059 | 1 | 1-80305A47 | CABLE ASSEMBLY, SYNTH | A5/A11 |
| 060 | 1 | 1-80305A48 | CABLE ASSEMBLY, OFFSET | A11/MOTHERBOARD |
| 061 | 1 | 1-80305A49 | CABLE ASSEMBLY 455KHz | A4/MOTHERBOARD |
| 062 | 1 | 1-80305A50 | CABLE ASSEMBLY 10.245 | A4/MOTHERBOARD |
| 063 | 1 | 1-80305A51 | CABLE ASSEMBLY 10 MHz | A13/A4 |
| 064 | 1 | 64-P06810R001 | PLATE, CONNECTOR, BLANK | |
| 065 | AR | | WIRE, SOLID BUS | 16 |
| 066 | 3 | 29-15159A03 | TERMINAL, LUG | |

| Find No. | Qty. Req. | Part No. | Nomenclature | Part Value |
|---|---|---|---|---|
| 068 | AR | | WIRE | 16 WHT |
| 069 | AR | SN63WRP3 | SOLDER | |
| 070 | AR | M23053/5-103-9 | INSULATION SLEEVING | .093 WHT |
| 071 | AR | | WIRE | 20 WHT |
| 072 | AR | | TAPE | NATURAL |
| 073 | AR | | WIRE | 24 WHT |
| 074 | AR | | INSULATION TAPE, MYLAR | 1IN YELLOW |
| 076 | AR | | COMPOUND, THD LKG, | BLUETYPE II, GAN, 242 |
| 077 | 1 | MS35489-9 | GROMMET | |
| 079 | AR | | ENCAPSULANT SILICONE | |
| 080 | 1 | 32-P0413ST001 | PAD, CRT CLAMP | |
| 081 | AR | | WIRE | 20 |
| 082 | 2 | 66105-4 | SOCKET | |
| 083 | 2 | MS35206-231 | SCREW | 6-32X.525 |
| 084 | 2 | 9225-A-140-10A | SPACER | .2500 X .38L |
| 085 | 3 | 33-14232A09 | IDENTIFICATION PLATE | HIGH VOLTAGE |
| 087 | AR | | WIRE | 18 WHT |
| 096 | 1 | 1-80305A54 | RELAY ASSEMBLY | |
| 097 | 1 | 1-80305A57 | CABLE ASSEMBLY, RIBBON | |
| 098 | 1 | 1-80305A59 | CABLE ASSEMBLY, RIBBON | |
| 099 | 1 | 1-80305A58 | CABLE ASSEMBLY, RIBBON | |
| 100 | 11 | MS24693-S2 | SCREW, FH | .112-40X.250 |
| 101 | 23 | 87666-2 | CONTACT, RECEPTACLE | |
| 102 | 1 | 42-80370A53 | CLIP, FLEX NYLON | |
| 105 | 1 | 66103-2 | CONTACT, PIN | 22 |
| 106 | 1 | 87077-2 | PLUG, KEYING | |
| 107 | 1 | 1-80385A53 | FAN ASSEMBLY | |
| 108 | 2 | 9070-NP | THUMB NUT, RD-HD | |
| 109 | 2 | 476155 | CLIP, MOUNTING | |
| 112 | 1 | 61-80331A44 | WINDOW, EMI | |
| 113 | 1 | 61-80331A42 | CRT, GRATICLE | |
| 114 | 1 | 26-P08059V001 | SHIELD, FRONT, CRT | |
| 115 | AR | M23053/5-104-C | INSULATION SLEEVING | .125 CLR |
| 117 | AR | M23053/5-102-9 | INSULATION SLEEVING | .063 WHT |
| 118 | 2 | SJ-5069 | BUMPER WHT | .88 DIA X .40H |
| A 001 | 1 | RTP-1005A | LOW VOLTAGE PWR SUPPLY | A1 |
| A 010 | 1 | RTP-1006A | HIGH VOLTAGE PWR SUPP | A10 |
| A 011 | 1 | RTC-1002B | RF FRONT END | A11 |
| A 012 | 1 | RTL-4086A | FRT PANEL INTRF ASSY | |
| A 013 | 1 | RTL-1011A | FREQUENCY STANDARD | INA13 |
| F 001 | 1 | 65-15161A25 | FUSE | 250V-8A |
| F 003 | 1 | 65-15161A19 | FUSE, CARTRIDGE | 250V-1 1/2A |
| J 002 | 1 | 09-80331A66 | CONNECTOR | |
| J 010 | 1 | 09-80396A91 | CONNECTOR | |
| J 014 | 1 | 15-10811A07 | CONNECTOR, BATTERY | 4-PIN MALE |
| J 015 | 1 | 28-80346A45 | CONNECTOR | POWER INPUT |
| J 016 | 1 | 9-80346A45 | CONNECTOR, BLOWER | 4 CONTACT |
| P 001 | 1 | 1-640440-0 | CONNECTOR | 10 PIN |
| P 002 | 1 | 87483-6 | CONTACT HOUSING-WIRE | |
| T 001 | 1 | 25-80369A11 | TRANSFORMER, LINE | |
| V 001 | 1 | 95-80396A23 | CATHODE RAY TUBE | |

Figure 6-3. Communications System Analyzer Parts Location Diagram (Sheet 3 of 3)

| Find No. | Qty. Req. | Part No. | Nomenclature | Part Value |
|---|---|---|---|---|
| 001 | 1 | 07-P07915V001 | BRACKET,MOUNTING,R | |
| 002 | 2 | 29-15095A53 | TERMINAL,STUD TEFL | |
| 003 | 1 | MS77070-1 | TERMINAL | |
| 004 | AR | SN63WRMAP3 | SOLDER | |
| 005 | AR | | WIRE | #22 WHT |
| 006 | AR | 11-14167A01 | INK | BLACK |
| 007 | 2 | MS35206-215 | SCREW,PH | 4-40X.375 |
| 008 | 2 | 04-114583 | WASHER,LOCK | .112 |
| 009 | 2 | MS27183-4 | WASHER,FLAT | NO.4 |
| 010 | 2 | NAS671-4 | NUT,HEX,LIGHT | 4-40 |
| 011 | AR | | WIRE | #24 |
| 012 | AR | | INSULATION SLEEVIN | #22 WHT TEF |
| CR001 | 1 | 48-86850C47 | DIODE | |
| K 001 | 1 | 80-80370A55 | RELAY | |
| R 001 | 1 | 06-125A31 | RESISTOR | 180-5-1/2 |




1-80305A54

Figure 6-4. Blower Relay Assembly Parts Location Diagram

# SECTION 7
# LOW VOLTAGE POWER SUPPLY (A1)

**7-1. GENERAL.** The low voltage power supply (figure 7-1) converts an AC line voltage input or a DC voltage input to the required DC operating voltages. The power supply is composed of four modules, each module containing a printed wiring board. These modules are the relay, control, switcher, and output modules. Protection circuits protect the power supply against short circuits, high internal temperatures, and high and low DC bus voltages.

**7-2. INPUT POWER CONTROL.** When AC power is applied to the power supply, the output of the AC rectifier and filter circuit provides the DC bus voltage. An AC sense circuit provides a control voltage when AC power is present. This control voltage isolates the DC voltage input from the DC bus and drives the front panel AC indicator.

7-3. The off, standby, or on operating mode of the power supply is selected by the control circuit. When the analyzer is off, the frequency standard and chopper generator are off, and the battery charger is on. When the analyzer is in standby, the chopper generator is off and the frequency standard and battery charger are on. When the analyzer is on, the frequency standard and chopper generator are on and the battery charger is off. Thus, the battery is charged when the analyzer is in the off and standby modes of operation. The frequency standard operates in the standby and on modes of operation.

7-4. The battery charger requires a voltage higher than the nominal DC bus voltage. This increased voltage, 32V, is provided by the AC boost circuit.

7-5. To operate the power supply using a DC voltage input, the AC power input must be removed, disabling the AC sense voltage. When the AC power is removed and the analyzer turned off, no power is present on the DC bus. When the analyzer is switched to the standby mode, the DC relay closes, connecting the DC voltage input to the DC bus and the supply voltage to the frequency standard. When the analyzer is switched on, the chopper generator is enabled and normal operation occurs.

**7-6. DC OUTPUT CONTROL.** Regulation of the DC output voltages is accomplished by using the +5volt output as feedback. This feedback voltage is compared to a stable reference voltage (7.9V). The resultant control voltage determines the on time of the pulse width modulator, thus regulating the input voltage to the chopper circuits. The output transformer winding ratios determine the output voltages with respect to the +5-volt feedback.

7-7. The chopper generator provides a 7-volt reference voltage, a 20-kHz squarewave chopper drive signal, and a 20 kHz triangular waveform. The pulse width modulator has a 50 percent duty cycle. For control voltages that are above or below the mean DC voltage of the triangular waveform, the duty cycle is proportionately increased or decreased.

7-8. The filtered DC output from the pulse width modulator is chopped 50 percent through the primary windings of output transformer T2 at a 20 kHz rate. The DC output is alternately switched between each half of the primary winding of T2. Current through the primary winding center tap is passed through a current transformer whose output is used for overcurrent protection.

**7-9. PROTECTION CIRCUIT.** This power supply is protected from shorted outputs, high internal temperatures, and high or low DC bus voltage. In each case, the protection circuit pulls the control voltage line low, disabling the pulse width modulator and shutting down the power supply outputs.

7-10. Short circuit protection is provided by monitoring the current in the primary winding of the output transformer T2. When an output is shorted, the primary winding current will increase significantly. This causes the overcurrent detector to pull the control voltage line low, disabling the pulse width modulator and shutting down the output. With the output shut down, there is no primary winding current, causing the control voltage line to be released. When the control voltage line is released, the pulse width modulator is again enabled and the power supply outputs are available again. If the short circuit is still present, the shutdown sequence will be repeated. A delay is provided in the overcurrent detector causing the shutdown sequence to cycle at an approximately 0.5 second rate.

7-11. Over temperature protection is provided by a thermal switch. When the temperature of the power supply exceeds the setting of the thermal switch, the switch closes, pulling the control voltage line low, disabling the pulse width modulator and shutting down the power supply outputs. Normal power supply operation will resume when the temperature returns to a safe operating level.

7-12. Protection against high or low DC or AC line inputs is provided by monitoring the DC bus voltage. When the DC bus voltage exceeds 20 volts, or falls below 10 volts, the high/low shutdown circuit pulls the control voltage line low, disabling the pulse width modulator and shutting down the power supply outputs. When the DC bus voltage returns to normal, the power supply will automatically resume normal operation.

**7-13. HIGH VOLTAGE CONTROL.** The HV BIAS V line and the HV SOURCE V line provide the high voltage power supply A10 with bias voltage and primary power, respectively.

**7-14. SWITCHER MODULE A1A1.** The switcher module (figure 7-4) contains the pulse width modulator and chopper circuits. The input PWM DRIVE signal, from the control module, switches the chopping circuit on and off. This produces a rectangular wave output which is filtered and applied to transformer choppers A and B. In effect, this action regulates the voltage which is applied to transformer T201 on the output module. The PWM OUT signal is a secondary input to the voltage regulator comparator on the control module.

7-15. Transformer choppers A and B are driven by CHOPPER DR A and CHOPPER DR B signals from the control module. Output signals XFMR DR A and XFMR DR B are 180-degrees out-of-phase and XFMR DR A1 and XFMR DR B1 are 180-degrees out-of-phase. An output, HV SOURCE V, from the chopping circuit is the primary power source for the high voltage power supply.

7-16. OVP (Overvoltage Protection). The OVP zener is connected to the +5V output from the output module and limits the maximum +5 volt level to +6.3 volts.

**7-17. OUTPUT MODULE A1A2.** The output module (figure 7-8) provides the regulated output voltages and the current sense voltage for the overcurrent protection circuit. Input power is provided by signals XMFR DR A, $A^1$, B, and $B^1$. These signals are 20 kHz squarewaves and drive the primary windings of transformer T201. After full wave rectification and filtering, the nominal output voltages are available as shown in figure 7-8.

7-18. The primary current of transformer T201 is monitored by transformer T202. The voltage developed across T202 is full wave rectified and applied to the current limit circuit on the control module by the CURRENT LIMIT SENSE signal. An increase in the primary current of T201 produces a corresponding increase in the voltage developed across T202. This increase is applied to the current limit circuit and overcurrent protection in initiated.

7-19. Regulation of the output voltage is accomplished by the +5-volt feedback. When the +5-volt output is regulated, the remaining output voltages will be regulated because of the turns ratio of the windings between the outputs. When the +5-volt output is held to one percent regulation, the other outputs will be held to five percent regulation.

7-20. The OVP (Overvoltage Protection) output is applied to a 6.2-volt zener diode mounted on the chopper assembly. This provides overvoltage protection to the +5-volt output.

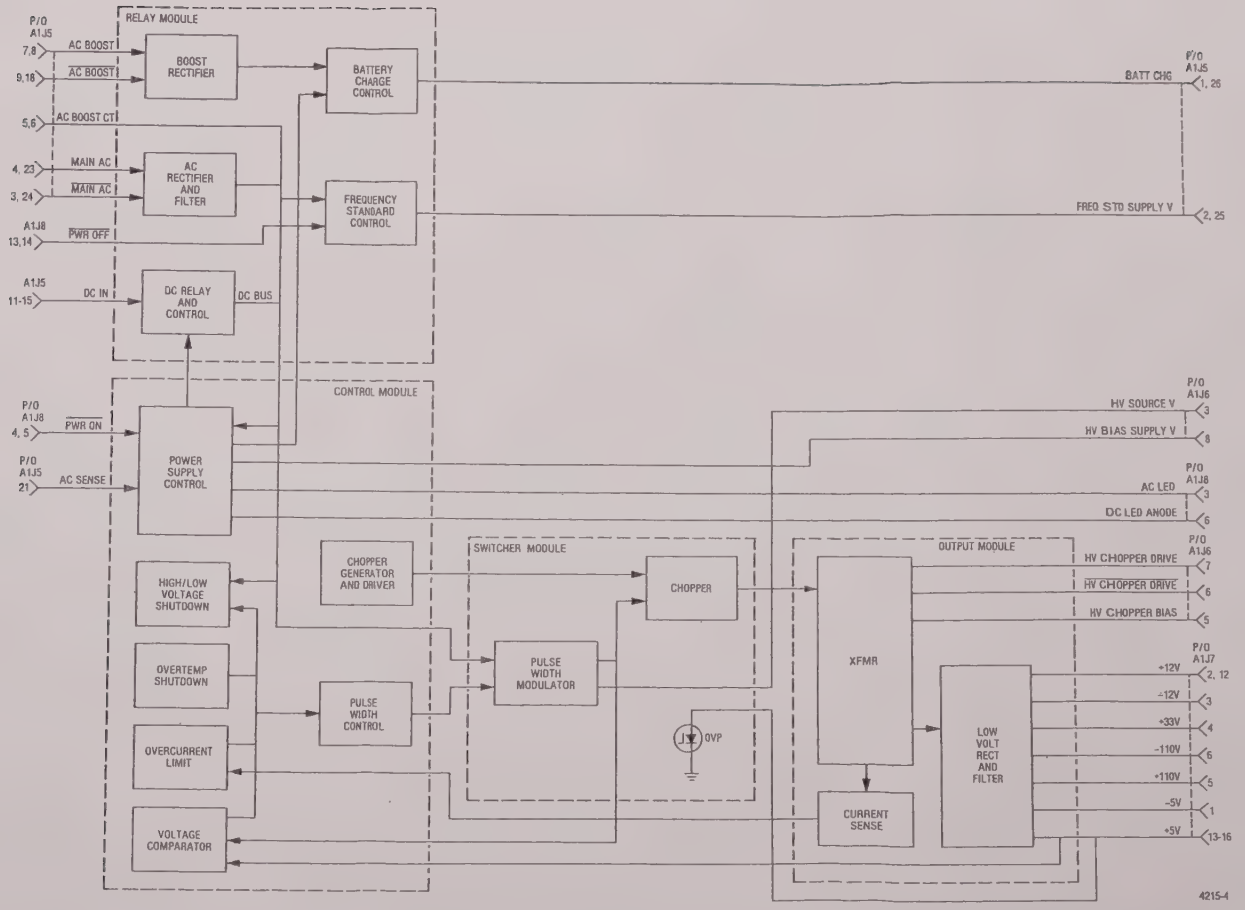



Figure 7-1. Low-Voltage Power Supply A1 Block Diagram

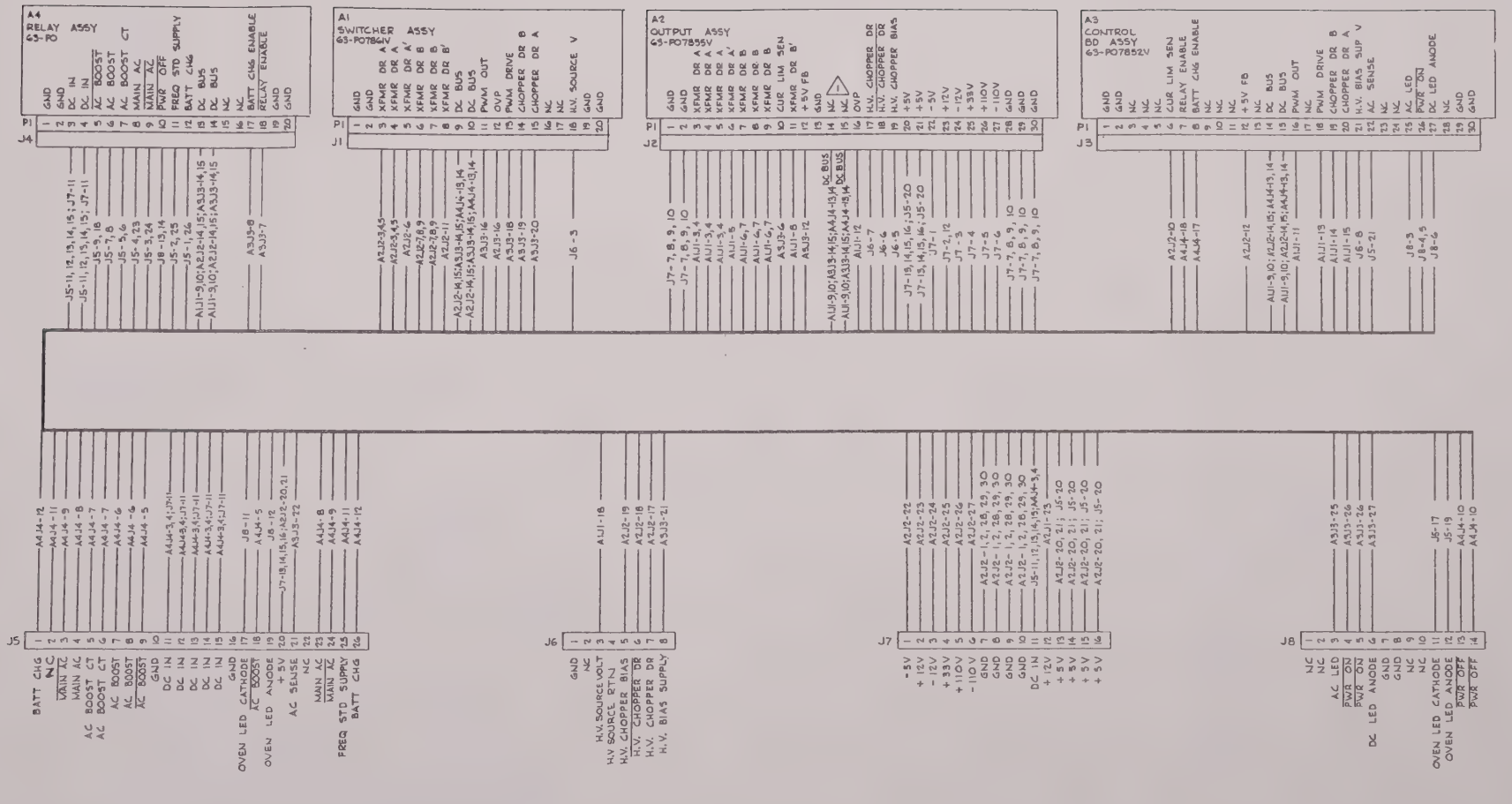



Figure 7-2. Low Voltage Power Supply A1 Interconneciton Diagram

**7-21. CONTROL MODULE A1A3.** The control module (figure 7-11) provides pulse width modulation control and contains the protection circuits. Pulse width modulation control is accomplished by comparing a 7.9V reference voltage to the +5-volt feedback from the output module. The resultant integrated control voltage is applied to the pulse width control. This voltage is compared to the 20 kHz triangle voltage to determine the duty cycle of the pulse width modulator. The chopper drive outputs are squarewaves and are 180-degrees out-of-phase with each other.

7-22. When the DC BUS voltage is over 20 or under 10 volts DC, the over/under voltage protection circuit pulls the control voltage signal to the pulsewidth control circuit low. This action shuts down the pulsewidth modulator.

7-23. The soft start circuit slows the rise time of the control signal to the pulsewidth control circuits. When the signal reaches the operating level the soft start circuit is switched out of the control loop.

7-24. The overcurrent detector compares a signal that is proportioned to the current in the current transformer, to a reference. When the current is too high, the control signal is pulled low, shutting down the output module. After a delay, the output module operates again, if the malfunction causing the overcurrent is still present, the module will shutdown again. This sequence will cycle at a 0.5 second rate until the malfunction is corrected.

7-25. When the internal temperature of the power supply rises above 85°C, the overtemp shutdown circuit causes the control signal to go low, shutting down the pulsewidth control circuit. The control logic functions are shown in table 7-1.

Table 7-1. Control Logic Functions

| Input Signals | | Output Signals | | | | |
|---|---|---|---|---|---|---|
| $\overline{\text{Pwr On}}$ | AC Sense | Batt Chr Enable | HV Bias Supply V | AC Led | DC Led Anode | $\overline{\text{Relay Enable}}$* |
| Low | Low | High | On | Off | On | Low |
| Low | High | Low | On | On | Off | High |
| High | Low | Low | Off | Off | Off | Low |
| High | High | High | Off | On | Off | High |

*Note that RELAY ENABLE low, does not imply that the relay is closed. The $\overline{\text{PWR OFF}}$ signal on the relay module must also be high to close the relay.

**7-26. RELAY MODULE A1A4.** The relay module (figure 7-14) is mounted on one end plate of the power supply. Primary power is applied to the module through a line transformer or the DC input. When an AC input is used, the $\overline{\text{RELAY ENABLE}}$ line is high, the relay is open, and the power supply operates from the AC input. The MAIN AC and MAIN AC lines receive a 13.5-volt AC rms input from the line transformer. After full wave rectification, the DC power is routed throughout the power supply on the DC bus. Filtering of the DC power is done on the switcher module.

7-27. When the DC input is used, the $\overline{\text{RELAY ENABLE}}$ line is low, the relay is closed, and the power supply operates from the DC input. The battery charge voltage is boosted to 32 volts using the AC bus voltage to bias an AC boost winding center top.

| Find No. | Qty. Req. | Part No. | Nomenclature | Part Value |
|---|---|---|---|---|
| 005 | 1 | 27-P07858V001 | CHASSIS,LVPS | |
| 006 | 6 | MS24693-S25 | SCREW,FH | .138-32X.312 |
| 007 | 6 | 03-139581 | SCREW,PH | 4-40X.312 |
| 008 | 6 | 04-114583 | WASHER,LOCK | .112 |
| 009 | 6 | 04-7607 | WASHER,FLAT | .125 |
| 011 | 3 | MS35206-227 | SCREW | .1380-32X.312 |
| 012 | 3 | MS35338-41 | WASHER | .138 |
| 013 | 3 | MS27183-6 | WASHER | .156 |
| 014 | AR | 11-14167A01 | INK | BLACK |
| A 001 | 1 | RTP-4016A | SWITCHER ASSEMBLY | |
| A 002 | 1 | RTP-4013A | OUTPUT PWB ASSEMBL | |
| A 003 | 1 | RTP-4012A | CONTROL PWB ASSEMB | |
| A 004 | 1 | 01-80305A58 | RELAY ASSEMBLY | |
| A 005 | 1 | RTP-4014A | MOTHER BOARD ASSEM | |

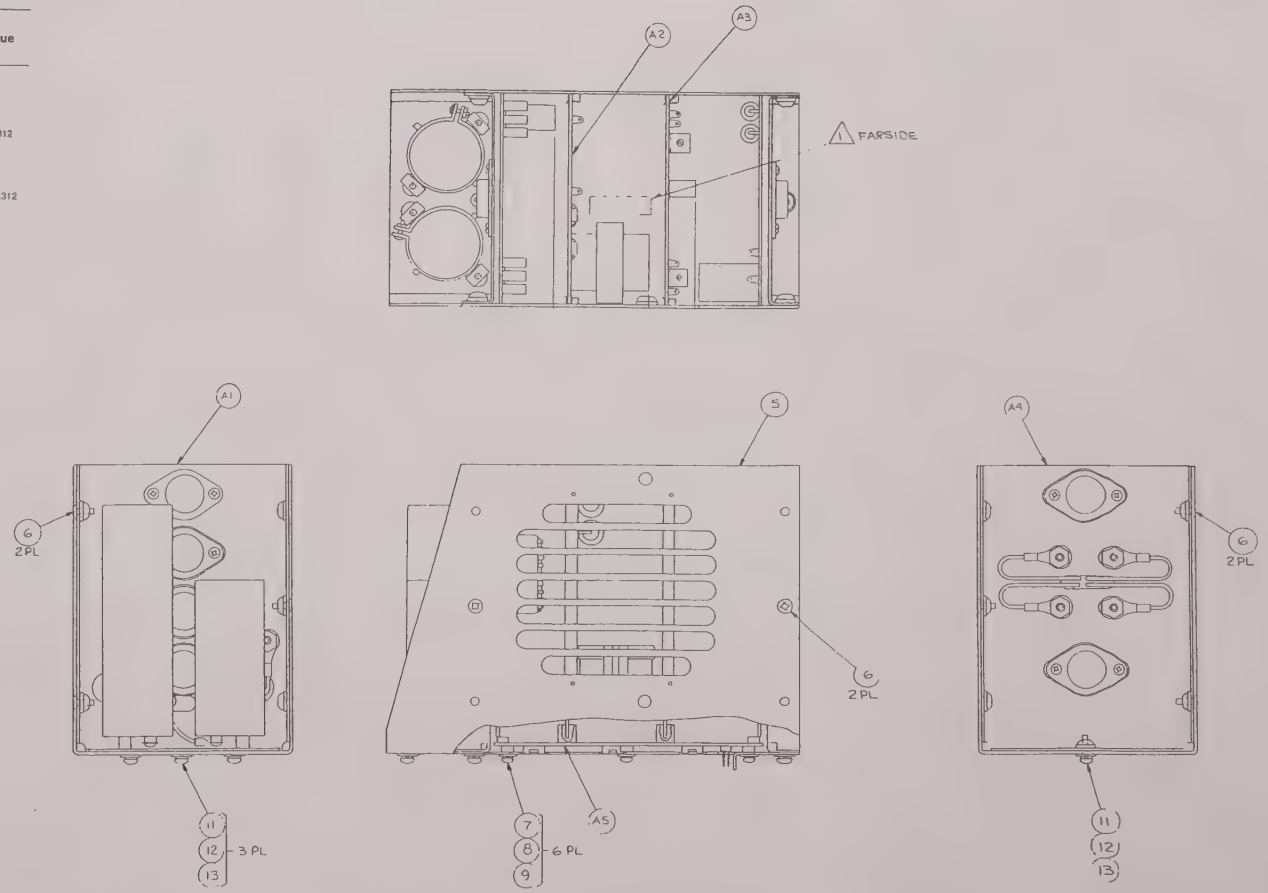



Figure 7-3. Low Voltage Power Supply A1(RTP-1005A) Parts Location Diagram

| Find No. | Qty. Req. | Part No. | Nomenclature | Part Value |
|---|---|---|---|---|
| 001 | 1 | 84-P07871V001 | MOTHER BOARD | |
| 002 | 6 | B1534-B-1/8-5 | SPACER,SWAGE | |
| 003 | AR | SN63WRP3 | SOLDER | |
| 004 | AR | 11-14167A01 | INK | BLACK |
| 005 | 2 | KFS2-256 | NUT,PRESS,MIN | |
| 006 | AR | M81822/6-A22-9 | WIRE,SOLID | #22 WHT,TEF |
| J 001 | 1 | 2-87633-0 | CONNECTOR | |
| J 002 | 1 | 09-80331A89 | CONNECTOR,EDGE CAR | |
| J 003 | 1 | 09-80331A89 | CONNECTOR,EDGE CAR | |
| J 004 | 1 | 2-87633-0 | CONNECTOR | |
| J 005 | 1 | 1-87227-3 | CONNECTOR | |
| J 006 | 1 | 09-80331A95 | SOCKET,SOLDER DIP | |
| J 007 | 1 | 09-80331A97 | SOCKET,SOLDER DIP | |
| J 008 | 1 | 09-80331A96 | SOCKET,SOLDER DIP | 14 PIN |

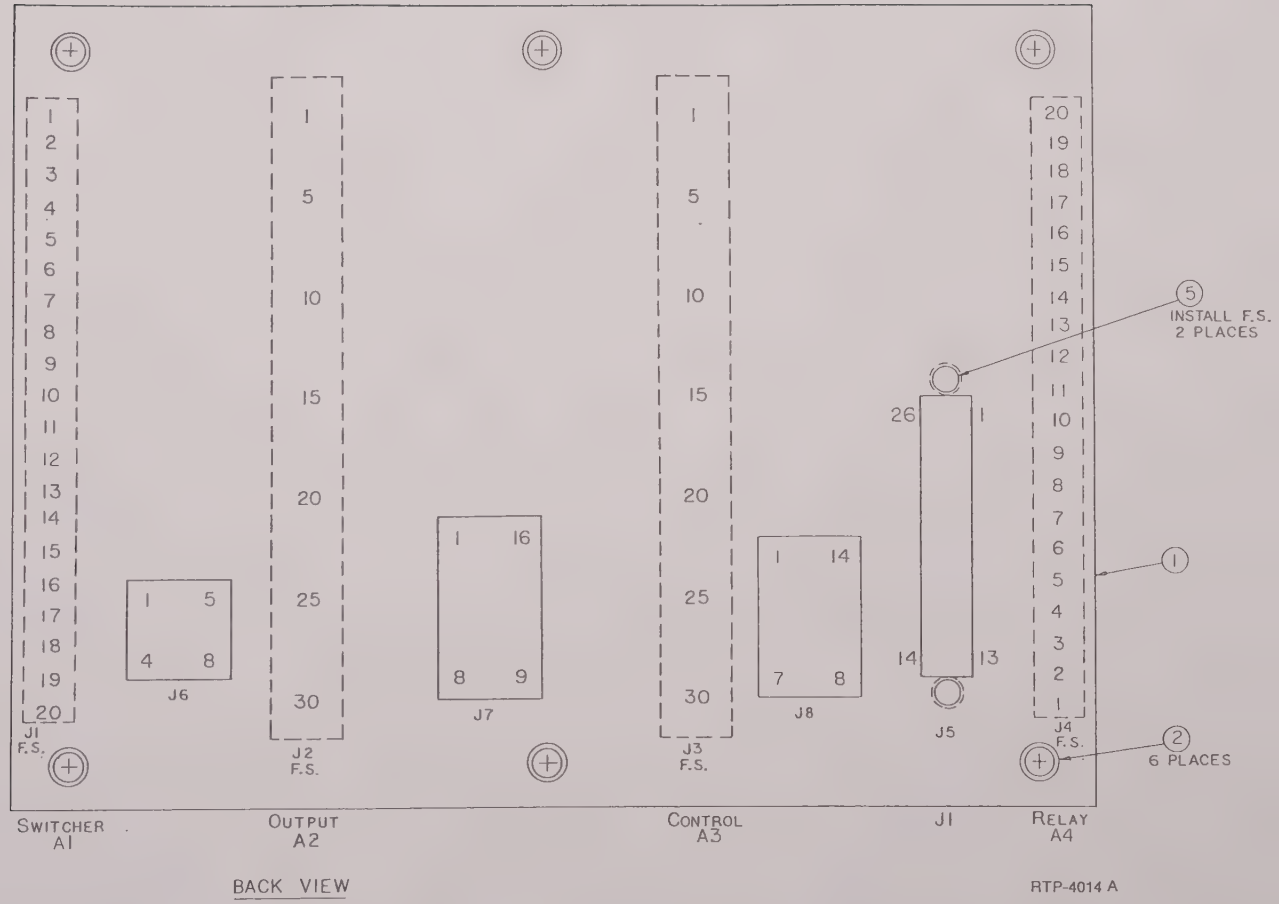



Figure 7-17. Low Voltage Power Supply A1 Motherboard Parts Location

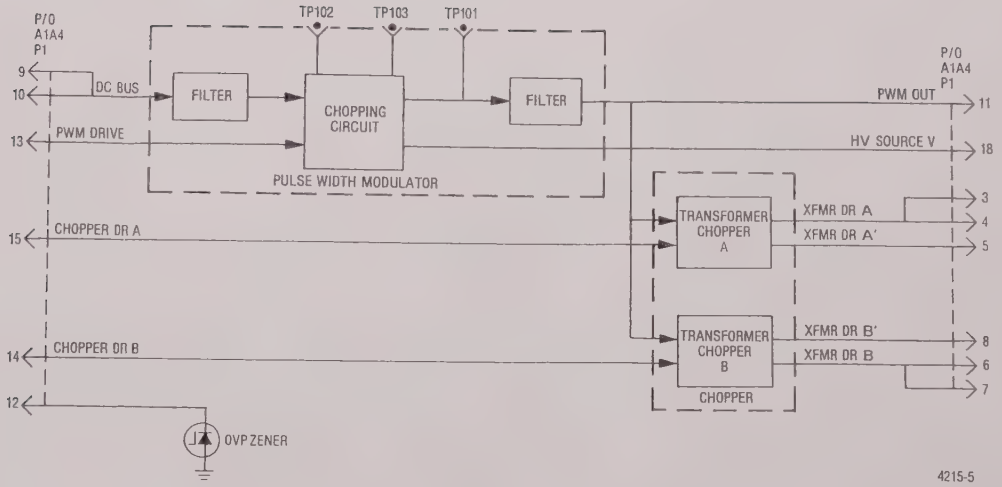



Figure 7-4. Low Voltage Power Supply Switcher Module A1A1 Block Diagram

NOTES:

1. PARTIAL REFERENCE DESIGNATIONS ARE SHOWN. FOR COMPLETE DESIGNATION PREFIX WITH A1.
2. FOR REFERENCE DRAWINGS REFER TO:
   01-P07891V SWITCHER ASSY
   01-P07862V SWITCHER PWB ASSY
3. UNLESS OTHERWISE SPECIFIED:
   ALL RESISTORS ARE IN OHMS, ±5 PCT, 1/4 WATT.
   ALL CAPACITORS ARE IN UF.
   ALL INDUCTORS ARE IN UH.
   ALL VOLTAGES ARE DC.
4. * — COMPONENTS MOUNTED TO PLATE SWITCH MOUNTING.

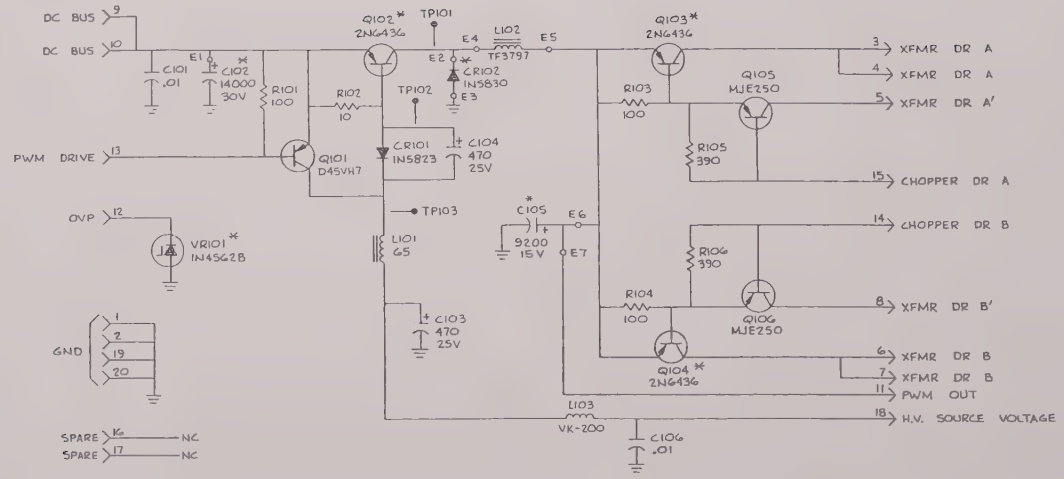



Figure 7-5. Low Voltage Power Supply Switcher Module A1A1 Schematic Diagram

| Find No. | Qty. Req. | Part No. | Nomenclature | Part Value |
|---|---|---|---|---|
| 001 | 1 | 84-P07863V001 | PRINTED WIRING BOA | |
| 002 | 1 | 2-87988-0 | CONNECTOR | |
| 003 | 7 | 1S6-17-8-20 | TERMINAL | |
| 004 | 6 | B1534-B-1/8-5 | SPACER,SWAGE | .125LG |
| 005 | 6 | B1534-B-3/32-5 | SPACER,SWAGE | .093LG |
| 006 | 3 | 6107B-14 | HEAT SINK | |
| 007 | 8 | 640206-1 | JACK,PC | |
| 008 | AR | SN63WRP3 | SOLDER | |
| 009 | AR | 11-14167A01 | INK | BLACK |
| 010 | 1 | 5607-84 | BUSHING,NYLON | |
| 011 | 1 | MS35206-234 | SCREW | .1380-32X1 |
| 012 | 1 | MS27183-5 | WASHER,FLAT | .156 |
| 013 | 1 | MS35338-41 | WASHER,LOCK | .138 |
| 014 | 1 | MS35649-262 | NUT,HEX | .1380-32 |
| 015 | 2 | 02-7019 | NUT | .1120-40 |
| 016 | 2 | 04-114583 | WASHER,LOCK | .112 |
| 018 | 2 | MS35206-216 | SCREW,P.H. | .1120-40X.438 |
| 019 | 2 | BS2200F006 | WASHER,COMP | |
| 020 | 1 | 14-80370A48 | INSULATOR,INDUCTOR | |
| 021 | AR | SN96WRMAP3 | SOLDER | |
| 022 | AR | M23053/5-206-C | INSULATION SLEEVIN | .250 CLR |
| 023 | 1 | 5607-4 | WASHER,SHOULDER | NO.2 |
| 024 | 1 | 03-15013G12 | SCREW,PH | 2-56X.375 |
| 025 | 1 | MS35338-39 | WASHER,LK | .086 |
| 026 | 1 | MS27183-2 | WASHER,FL | .094 |
| 027 | 1 | MS35649-222 | NUT,HEX | .0860-56 |
| 028 | 2 | 14-80370A46 | INSULATOR | |
| 029 | 1 | B08853A001 | INSULATOR,MICA | |
| C 101 | 1 | 21-80396A52 | CAPACITOR | .01UF-20+80-200 |
| C 103 | 1 | 23-80369A77 | CAPACITOR | 470UF-25V |
| C 104 | 1 | 23-80369A77 | CAPACITOR | 470UF-25V |
| C 106 | 1 | 21-80396A52 | CAPACITOR | .01UF-20+80-200 |
| CR101 | 1 | 48-80346A67 | DIODE | 20V-5A |
| L 101 | 1 | 25C84148F01 | INDUCTOR | 65UH |
| L 102 | 1 | 24-80369A54 | INDUCTOR | 57MH |
| L 103 | 1 | 24-80369A46 | COIL | |
| Q 101 | 1 | 48-80368A86 | TRANSISTOR | |
| Q 105 | 1 | 48-80368A88 | TRANSISTOR | |
| Q 106 | 1 | 48-80368A88 | TRANSISTOR | |
| R 101 | 1 | 6S124A25 | RESISTOR | 100-5-1/4 |
| R 102 | 1 | 6S124A01 | RESISTOR | 10-5-1/4 |
| R 103 | 1 | 6S124A25 | RESISTOR | 100-5-1/4 |
| R 104 | 1 | 6S124A25 | RESISTOR | 100-5-1/4 |
| R 105 | 1 | 6S124A39 | RESISTOR | 390-5-1/4 |
| R 106 | 1 | 6S124A39 | RESISTOR | 390-5-1/4 |
| TP101 | 1 | 09-80331A88 | JACK,TIP | WHT |
| TP102 | 1 | 09-80331A88 | JACK,TIP | WHT |
| TP103 | 1 | 09-80331A88 | JACK,TIP | WHT |

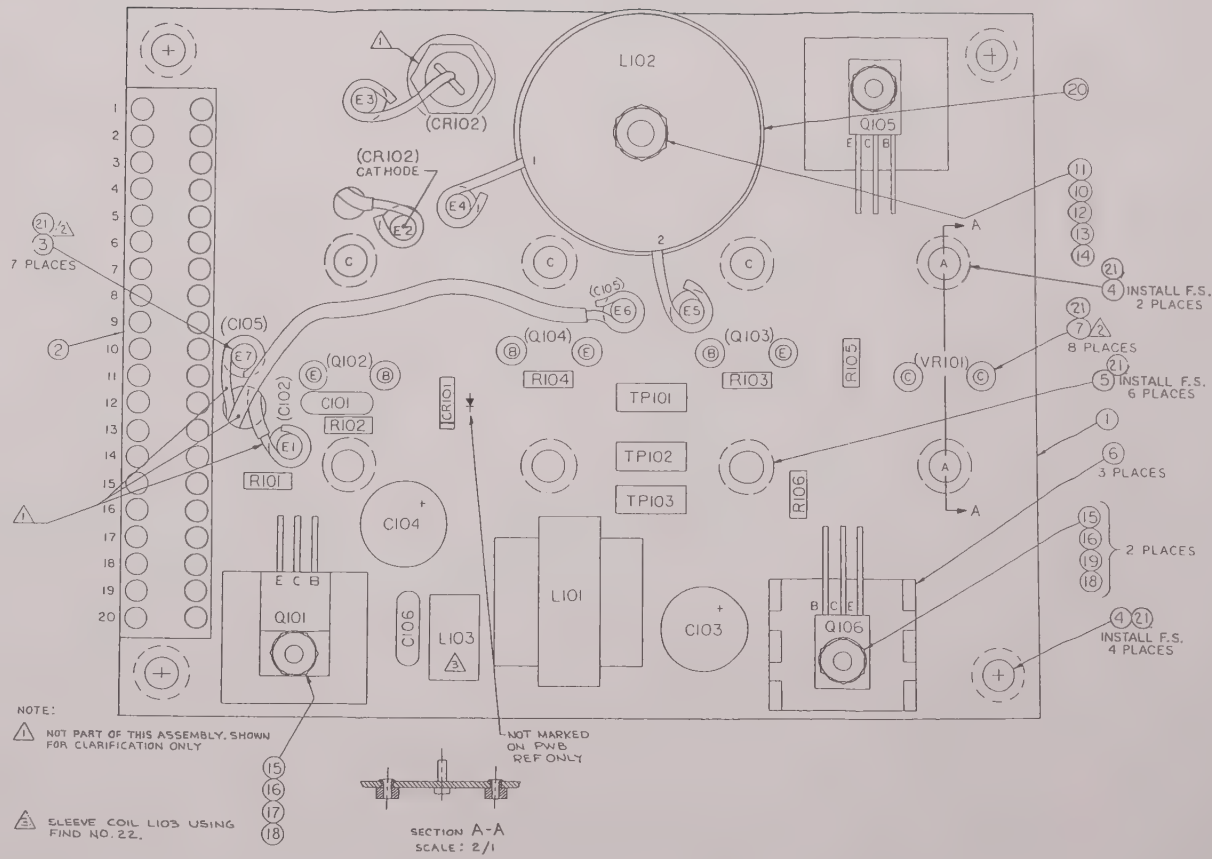



Figure 7-7. Low Voltage Power Supply Switcher Module A1A1 PWB Parts Location Diagram

| Find No. | Qty. Req. | Part No. | Nomenclature | Part Value |
|---|---|---|---|---|
| 001 | 1 | 01-80305A68 | SWITCHER PWB ASSEM | |
| 002 | 1 | 64-P07867V001 | PLATE,MOUNTING SWI | |
| 003 | 1 | B51566F020 | WASHER,LOCK | NO.10 |
| 004 | 1 | B51568F015 | NUT,HEX | 10-32 |
| 005 | 1 | M38527/8-76P | INSULATOR,PLATE,FI | STUD MT |
| 006 | 1 | B-225-10X | TERMINAL,CRIMP INSU | NO.10 |
| 007 | 1 | 5607-99 | WASHER,SHOULDER | |
| 008 | 3 | M38527/8-03P | INSULATOR,PLATE,FI | TO-3 |
| 009 | 6 | 5607-171 | WASHER,SHOULDER | |
| 010 | 2 | 42-P08107V001 | CLAMP,CAPACITOR | M/F 4586-97A |
| 011 | 6 | C9029-4Z-1 | CLIP,FASTENER | |
| 012 | 4 | MS51861-14 | SCREW | .112-24X.375 |
| 014 | 2 | MS35207-263 | SCREW | .1900-32X.500 |
| 015 | 2 | MS27183-8 | WASHER,FL | .219 |
| 016 | 4 | MS35333-39 | WASHER,LK,INTERNAL | .190 |
| 017 | 2 | MS35207-260 | SCREW | .1900-32X.312 |
| 018 | 2 | MS20659-104 | TERMINAL,LUG-CRIMP | |
| 019 | 12 | MS35206-215 | SCREW,PH | .1120-40X.375 |
| 020 | 4 | 04-7607 | WASHER,FLAT | .125 |
| 021 | 4 | 04-114583 | WASHER,LOCK | .112 |
| 022 | AR | | WIRE,ELEC | #14 WHT |
| 023 | AR | SN63WRP3 | SOLDER | |
| 025 | AR | 11-14167A01 | INK | BLACK |
| 026 | 2 | 1186-10-B-5 | SPACER | |
| 027 | AR | RTI-125#1BLK | INSULATION SLEEVIN | .220 BLK |
| 028 | 8 | MS35335-29 | WASHER,LK,EXTERNAL | .112 |
| 029 | AR | | WIRE,TEF INS | #22 WHT |
| 030 | AR | | WIRE,SOLID BUS | #22 |
| 031 | 2 | MS51861-15 | SCREW | .112-24X.500 |
| C 102 | 1 | 23-80369A69 | CAPACITOR | 14000UF-30V |
| C 105 | 1 | 23-80369A70 | CAPACITOR | 9200UF-15V |
| CR102 | 1 | 48-80368A99 | DIODE | |
| Q 102 | 1 | 48-80345A61 | TRANSISTOR | |
| Q 103 | 1 | 48-80345A61 | TRANSISTOR | |
| Q 104 | 1 | 48-80345A61 | TRANSISTOR | |
| VR101 | 1 | 48-80345A79 | DIODE | |

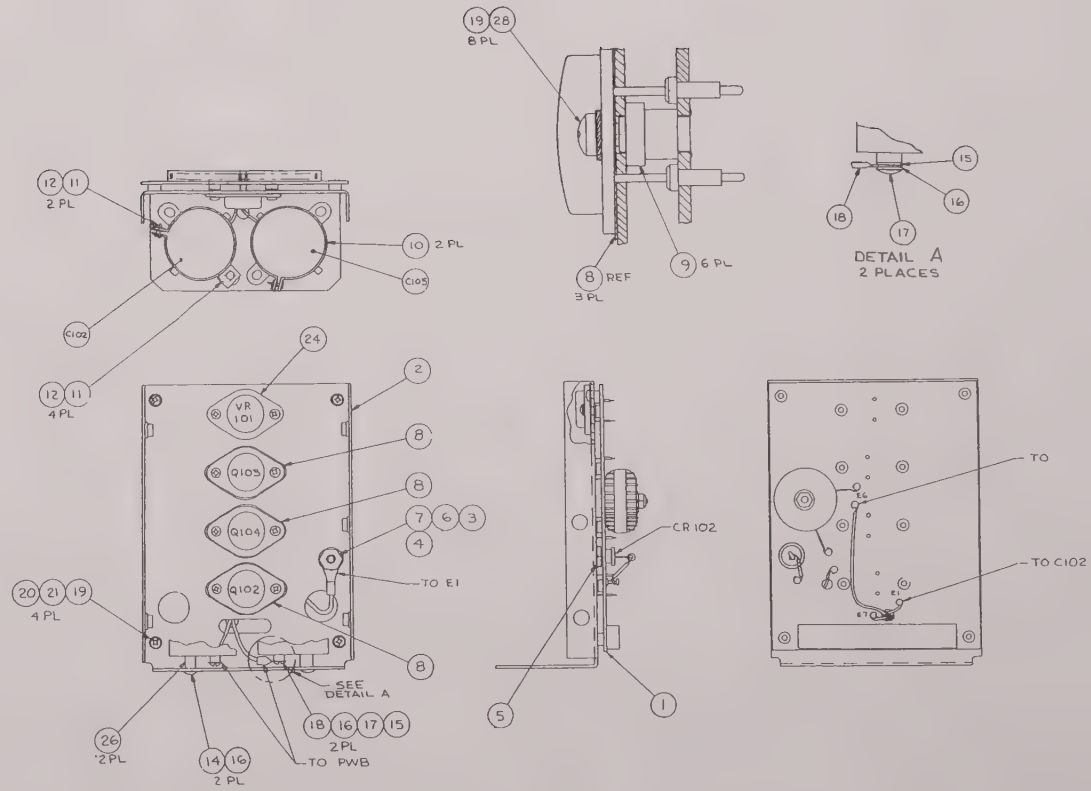



Figure 7-6. Low Voltage Power Supply Switcher Module A1A1 (RTP-4016A) Parts Location Diagram

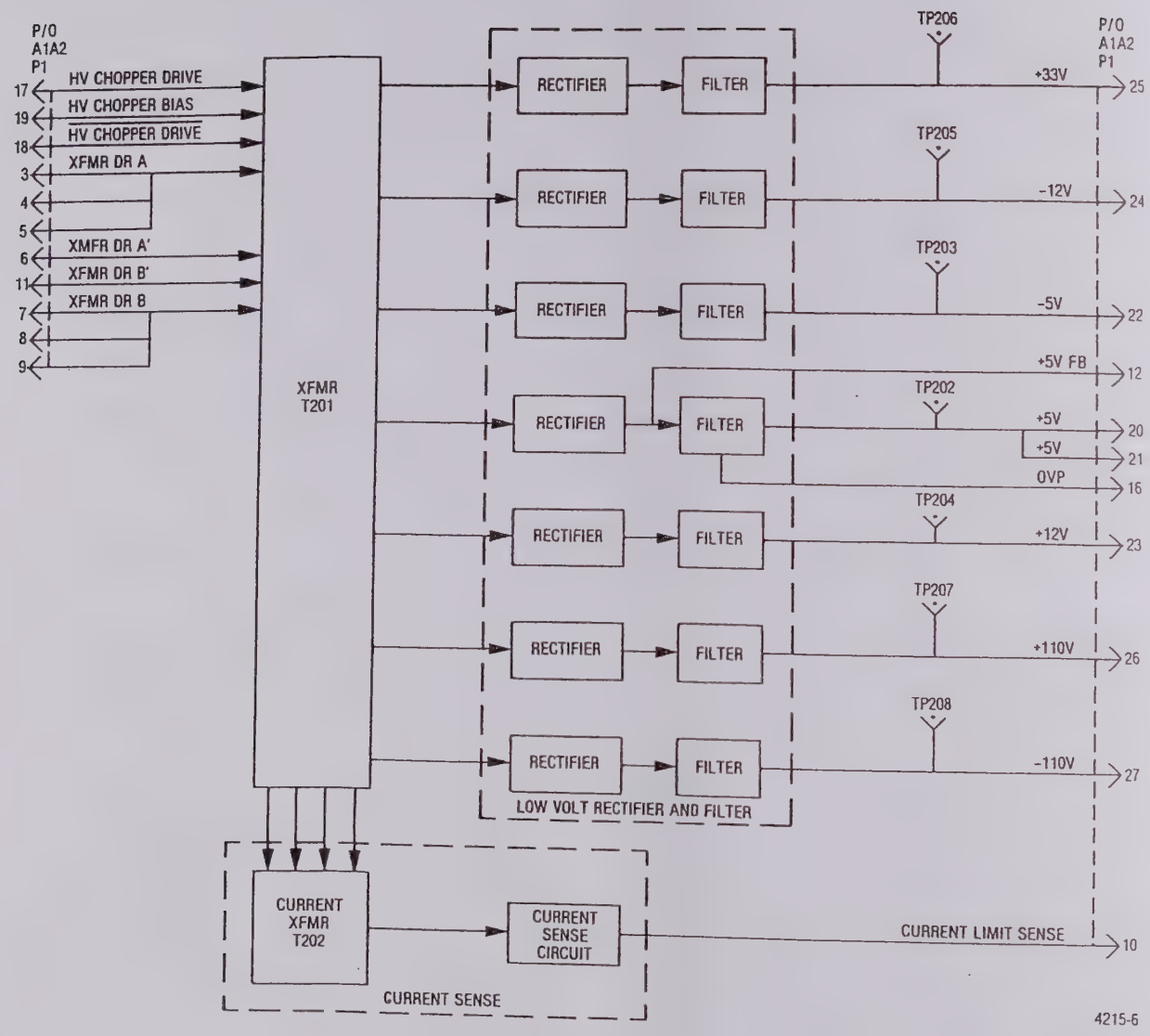



Figure 7-8. Low Voltage Power Supply Output Module A1A2 Block Diagram

Figu

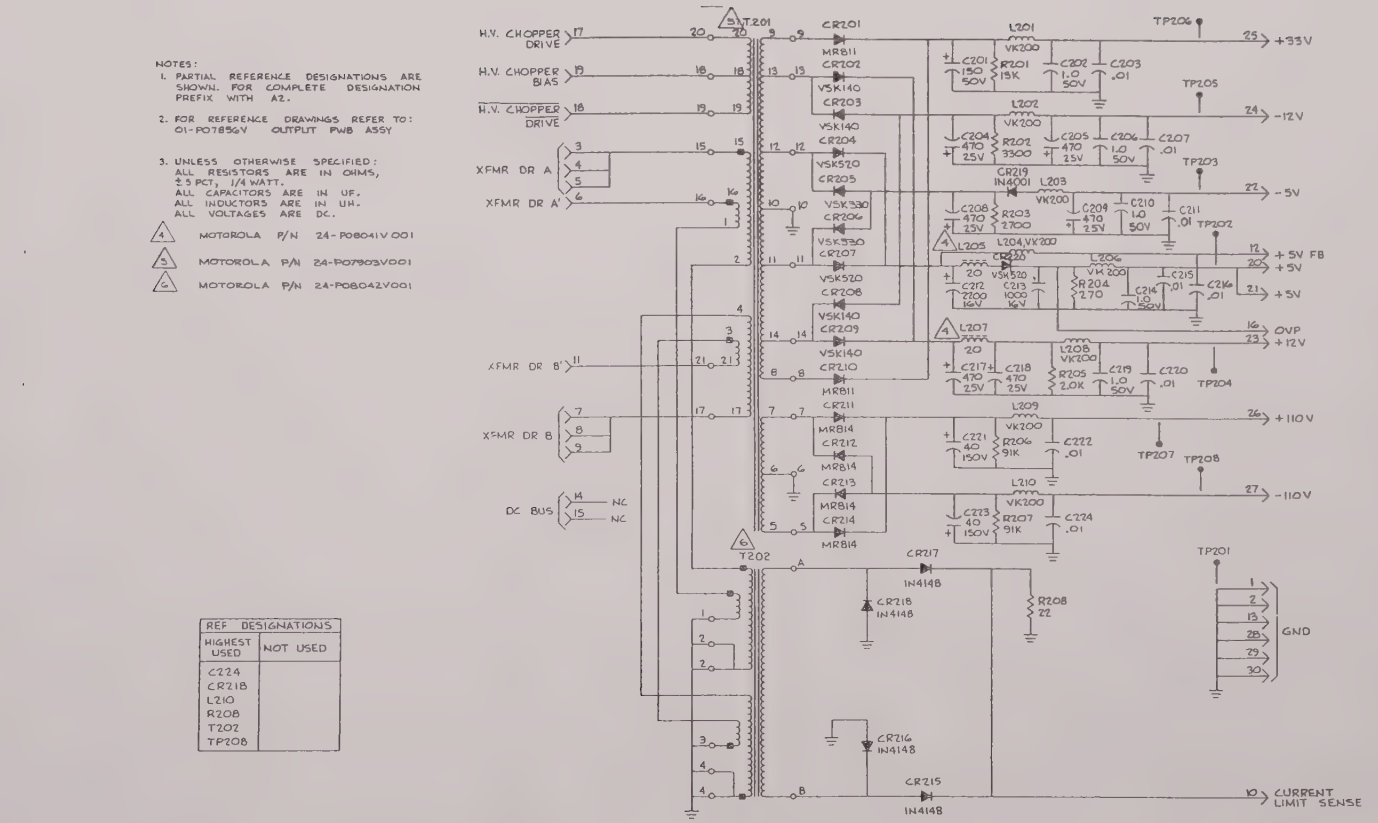



Figure 7-9. Low Voltage Power Supply Output Module A1A2 Schematic Diagram

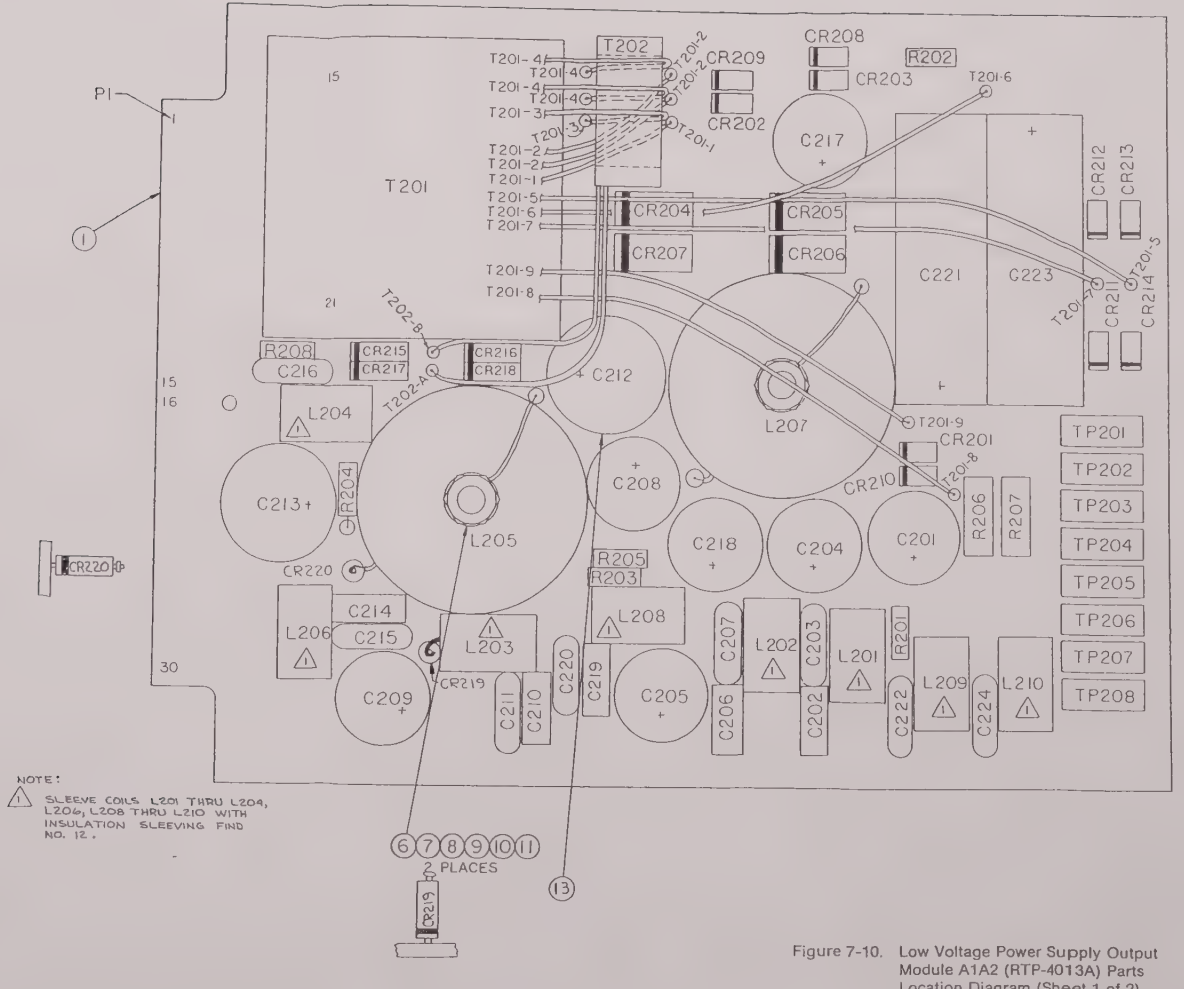



Figure 7-10. Low Voltage Power Supply Output Module A1A2 (RTP-4013A) Parts Location Diagram (Sheet 1 of 2)

| Find No. | Qty. Req. | Part No. | Nomenclature | Part Value |
|---|---|---|---|---|
| 001 | 1 | 84-P07857V001 | PRINTED WIRING BOA | |
| 003 | AR | SN63WRP3 | SOLDER | |
| 004 | AR | 11-14167A01 | INK | BLACK |
| 006 | 2 | 5607-84 | WASHER,SHOULDER | |
| 007 | 2 | MS35206-232 | SCREW,PH | .1380-32X.750 |
| 008 | 2 | MS35338-41 | WASHER,LOCK | .138 |
| 009 | 2 | MS27183-5 | WASHER,FLAT | .156 |
| 010 | 2 | MS35649-262 | NUT,HEX | .1380-32 |
| 011 | 2 | 14-15140A04 | INSULATOR,INDUCTOR | |
| 012 | AR | M23053/5-206-C | INSULATION SLEEVIN | .250 CLR |
| 013 | 1 | 5612-91-31 | WASHER,TEFLON | |
| C 201 | 1 | 23-80368A75 | CAPACITOR | 150UF-50V |
| C 202 | 1 | 2C30Z5U105Z050B | CAPACITOR | 1UF-20+80-50 |
| C 203 | 1 | 21-80396A52 | CAPACITOR | .01UF-20+80-200 |
| C 204 | 1 | 23-80396A44 | CAPACITOR | 470UF-25V |
| C 205 | 1 | 23-80396A44 | CAPACITOR | 470UF-25V |
| C 206 | 1 | 2C30Z5U105Z050B | CAPACITOR | 1UF-20+80-50 |
| C 207 | 1 | 21-80396A52 | CAPACITOR | .01UF-20+80-200 |
| C 208 | 1 | 23-80396A44 | CAPACITOR | 470UF-25V |
| C 209 | 1 | 23-80396A44 | CAPACITOR | 470UF-25V |
| C 210 | 1 | 2C30Z5U105Z050B | CAPACITOR | 1UF-20+80-50 |
| C 211 | 1 | 21-80396A52 | CAPACITOR | .01UF-20+80-200 |
| C 212 | 1 | 23-80369A76 | CAPACITOR | 2200UF-16V |
| C 213 | 1 | 23-80369A74 | CAPACITOR | 1000UF-16V |
| C 214 | 1 | 2C30Z5U105Z050B | CAPACITOR | 1UF-20+80-50 |
| C 215 | 1 | 21-80396A52 | CAPACITOR | .01UF-20+80-200 |
| C 216 | 1 | 21-80396A52 | CAPACITOR | .01UF-20+80-200 |
| C 217 | 1 | 23-80396A44 | CAPACITOR | 470UF-25V |
| C 218 | 1 | 23-80396A44 | CAPACITOR | 470UF-25V |
| C 219 | 1 | 2C30Z5U105Z050B | CAPACITOR | 1UF-20+80-50 |
| C 220 | 1 | 21-80396A52 | CAPACITOR | .01UF-20+80-200 |
| C 221 | 1 | 23-80369A67 | CAPACITOR | 40UF-150V |
| C 222 | 1 | 21-80396A52 | CAPACITOR | .01UF-20+80-200 |
| C 223 | 1 | 23-80369A67 | CAPACITOR | 40UF-150V |
| C 224 | 1 | 21-80396A52 | CAPACITOR | .01UF-20+80-200 |
| CR201 | 1 | 48-80345A69 | DIODE | 100V-1A |
| CR202 | 1 | 48-80346A56 | DIODE | 40V-1A |
| CR203 | 1 | 48-80346A56 | DIODE | 40V-1A |
| CR204 | 1 | 48-80346A67 | DIODE | 20V-5A |
| CR205 | 1 | 48-80368A94 | DIODE | 30V-3A |
| CR206 | 1 | 48-80368A94 | DIODE | 30V-3A |
| CR207 | 1 | 48-80346A67 | DIODE | 20V-5A |
| CR208 | 1 | 48-80346A56 | DIODE | 40V-1A |
| CR209 | 1 | 48-80346A66 | DIODE | 40V-1A |
| CR210 | 1 | 48-80345A69 | DIODE | 100V-1A |
| CR211 | 1 | 48-80345A70 | DIODE | 400V-1A |
| CR212 | 1 | 48-80345A70 | DIODE | 400V-1A |
| CR213 | 1 | 48-80345A70 | DIODE | 400V-1A |
| CR214 | 1 | 48-80345A70 | DIODE | 400V-1A |
| CR215 | 1 | 48-84463K02 | DIODE | |
| CR216 | 1 | 48-84463K02 | DIODE | |
| CR217 | 1 | 48-84463K02 | DIODE | |
| CR218 | 1 | 48-84463K02 | DIODE | |
| CR219 | 1 | 48-86850C47 | DIODE | |
| CR220 | 1 | 48-80346A67 | DIODE | 20V-5A |
| L 201 | 1 | 24-80369A46 | COIL | |
| L 202 | 1 | 24-80369A46 | COIL | |
| L 203 | 1 | 24-80369A46 | COIL | |
| L 204 | 1 | 24-80369A46 | COIL | |
| L 205 | 1 | 24-80369A55 | CHOKE | 20UH |
| L 206 | 1 | 24-80369A46 | COIL | |
| L 207 | 1 | 24-80369A55 | CHOKE | 20UH |
| L 208 | 1 | 24-80369A46 | COIL | |
| L 209 | 1 | 24-80369A46 | COIL | |
| L 210 | 1 | 24-80369A46 | COIL | |
| R 201 | 1 | 6S124A76 | RESISTOR | 13K-5-1/4 |
| R 202 | 1 | 6S124A61 | RESISTOR | 3.3K-5-1/4 |
| R 203 | 1 | 6S124A59 | RESISTOR | 2.7K-5-1/4 |
| R 204 | 1 | 6S124A35 | RESISTOR | 270-5-1/4 |
| R 205 | 1 | 6S124A56 | RESISTOR | 2.0K-5-1/4 |
| R 206 | 1 | 6S125A96 | RESISTOR | 91K-5-1/2 |
| R 207 | 1 | 6S125A96 | RESISTOR | 91K-5-1/2 |
| R 208 | 1 | 6S124A09 | RESISTOR | 22-5-1/4 |
| T 201 | 1 | 25-80369A12 | TRANSFORMER | |
| T 202 | 1 | 24-80369A56 | TRANSFORMER | |
| TP201 | 1 | 09-80331A88 | JACK,TIP | WHT |
| TP202 | 1 | 09-80331A88 | JACK,TIP | WHT |
| TP203 | 1 | 09-80331A88 | JACK,TIP | WHT |
| TP204 | 1 | 09-80331A88 | JACK,TIP | WHT |
| TP205 | 1 | 09-80331A88 | JACK,TIP | WHT |
| TP206 | 1 | 09-80331A88 | JACK,TIP | WHT |
| TP207 | 1 | 09-80331A88 | JACK,TIP | WHT |
| TP208 | 1 | 09-80331A88 | JACK,TIP | WHT |

Figure 7-10. Low Voltage Power Supply Output Module A1A2 (RTP-4013A) Parts Location Diagram (Sheet 2 of 2)

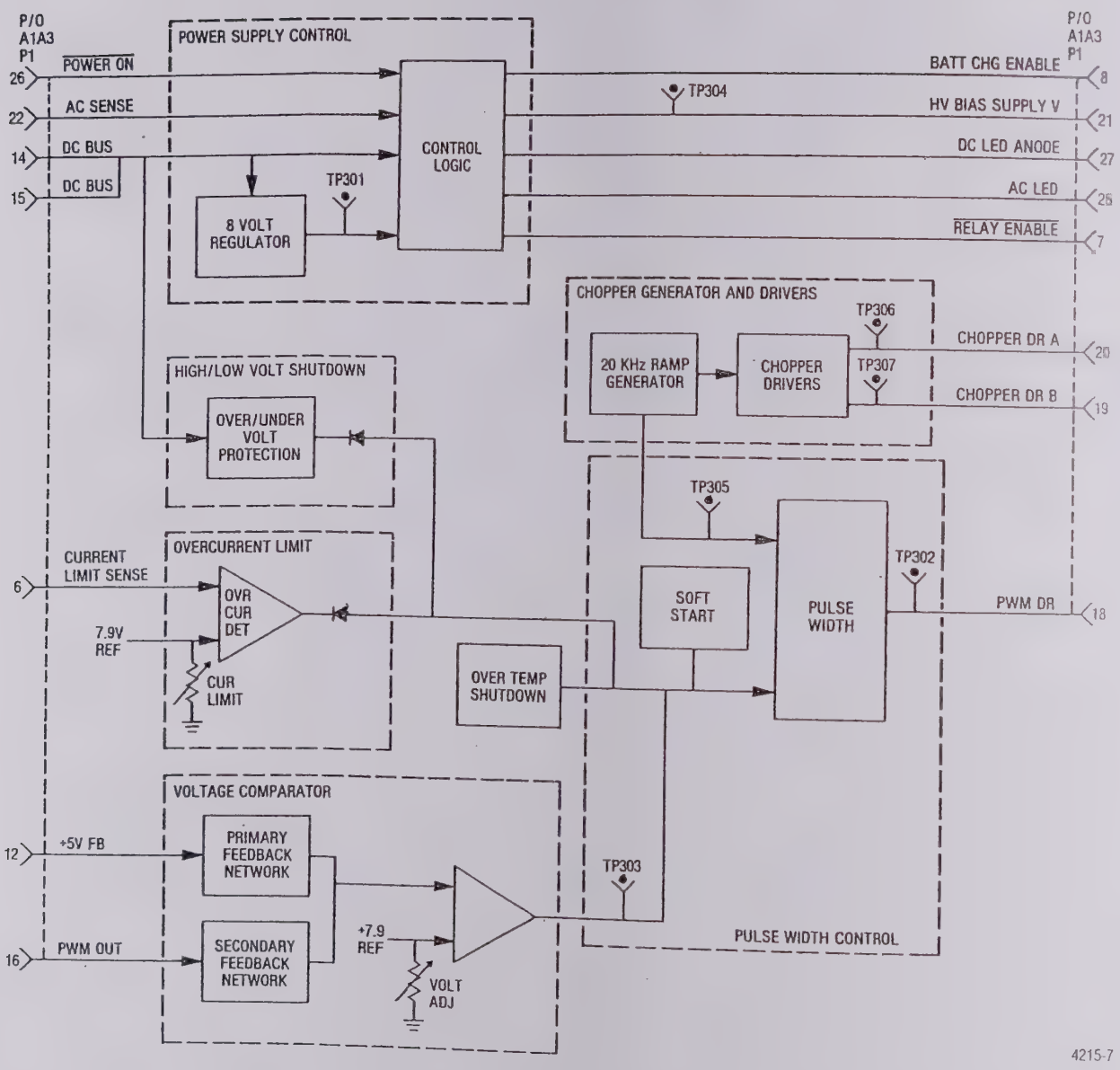



Figure 7-11. Low-Voltage Power Supply Control Module A1A3 Block Diagram

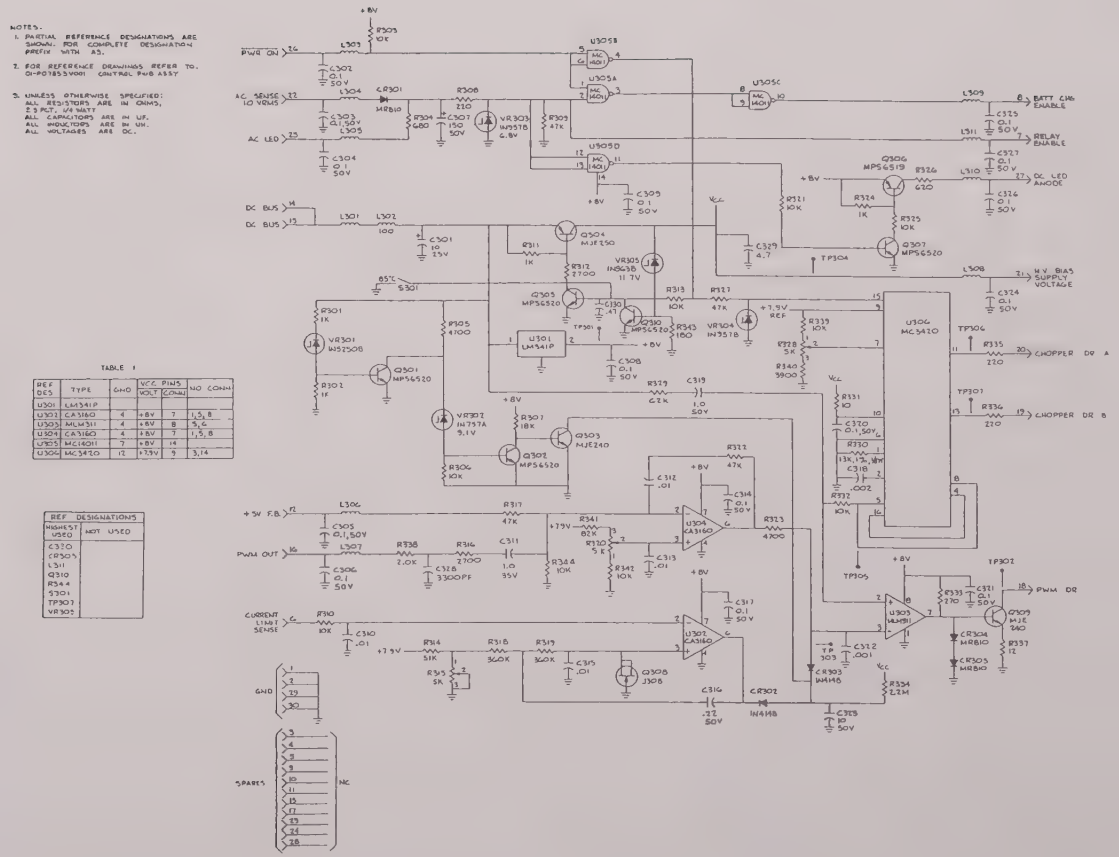

NOTES:
1. PARTIAL REFERENCE DESIGNATIONS ARE SHOWN. FOR COMPLETE DESIGNATION PREFIX WITH A5.
2. FOR REFERENCE DRAWINGS REFER TO 01-P07853V001 CONTROL PWB ASSY
3. UNLESS OTHERWISE SPECIFIED: ALL RESISTORS ARE IN OHMS, ±5 PCT, 1/8 WATT ALL CAPACITORS ARE IN UF. ALL INDUCTORS ARE IN UH. ALL VOLTAGES ARE DC.
TABLE 1
REF DES | TYPE | GND | VCC PINS VOLT | VCC PINS CONN | NO CONN
U301 | LM1391P
U302 | CA3160 | 4 | +8V | 7 | 1,5,8
U303 | MLM311 | 4 | +8V | 8 | 5,6
U304 | CA3160 | 4 | +8V | 7 | 1,5,8
U305 | MC14011 | 7 | +8V | 14
U306 | MC5420 | 12 | +7.9V | 9 | 3,14
REF DESIGNATIONS
HIGHEST USED | NOT USED
C370
CR303
L311
Q310
R344
S301
TP303
VR303
+8V
PWR ON
AC SENSE
AC LED
DC BUS
DC BUS
S301
+5V F.B.
PWM OUT
CURRENT LIMIT SENSE
GND
SPARES
NC
BATT CHG ENABLE
RELAY ENABLE
DC LED ANODE
H.V. BIAS SUPPLY VOLTAGE
CHOPPER DR A
CHOPPER DR B
PWM DR

Figure 7-12. Low Voltage Power Supply Control Module A1A3 Schematic Diagram

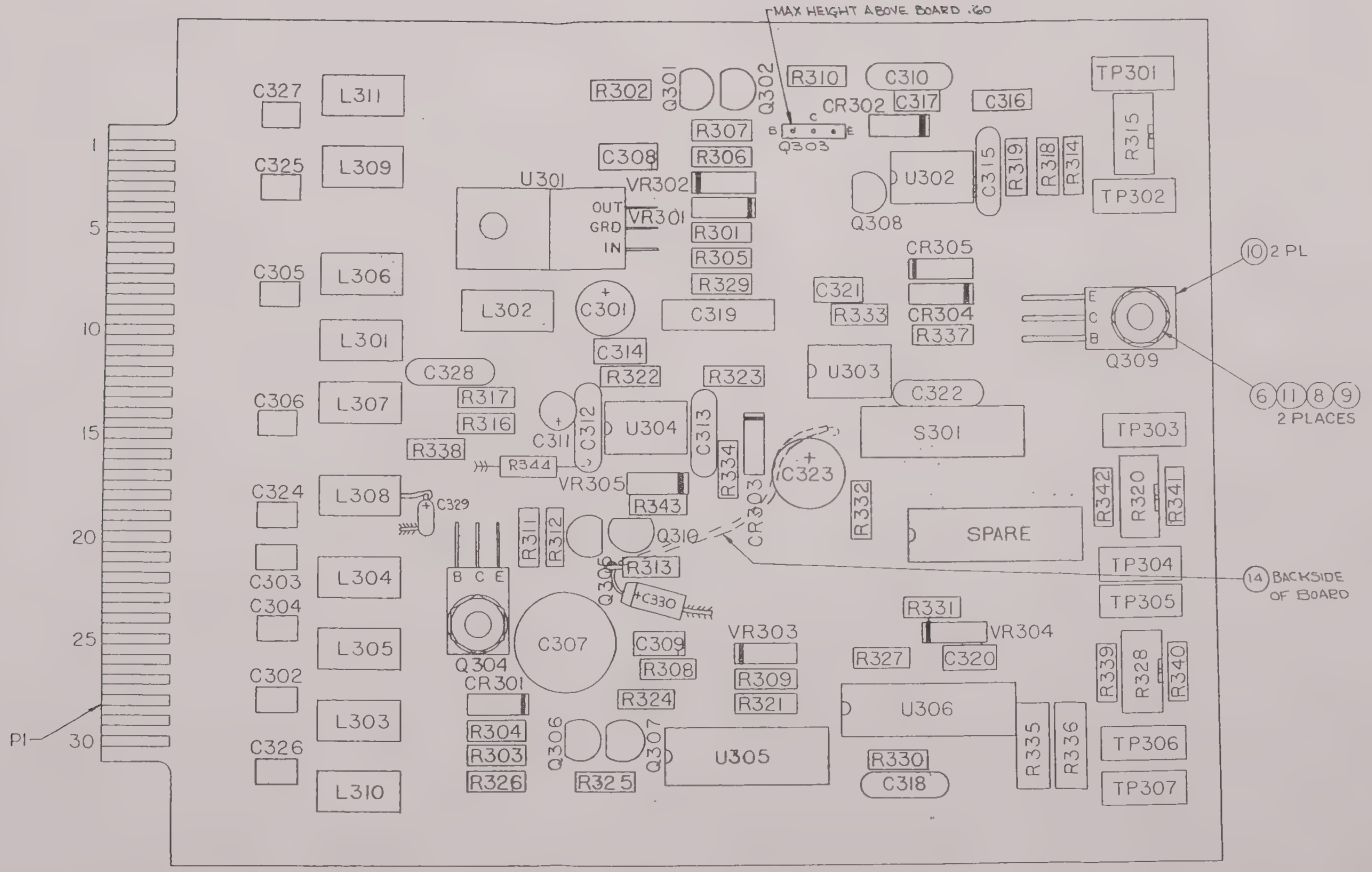



Figure 7-13. Low Voltage Power Supply Control Module A1A3 (RTP-4012A) Parts Location Diagram (Sheet 1 of 2)

| Find No. | Qty. Req. | Part No. | Nomenclature | Part Value |
|---|---|---|---|---|
| 001 | 1 | 84-P07854V001 | PRINTED WIRING BOA | |
| 003 | AR | SN63WRP3 | SOLDER | |
| 004 | AR | 11-14167A01 | INK | BLACK |
| 006 | 2 | MS35206-217 | SCREW,PH | .1120-40X.500 |
| 008 | 2 | 04-114583 | WASHER,LOCK | .112 |
| 009 | 2 | 02-7019 | NUT | .1120-40 |
| 010 | 2 | 14-80370A46 | INSULATOR | |
| 011 | 2 | B52200F006 | WASHER,COMP | |
| 014 | AR | | WIRE,SOLID | #24 WHT,TEFLON |
| C 301 | 1 | 23-80396A40 | CAPACITOR | 10UF-25V |
| C 302 | 1 | 21-80370A31 | CAPACITOR | .1UF-20-50 |
| C 303 | 1 | 21-80370A31 | CAPACITOR | .1UF-20-50 |
| C 304 | 1 | 21-80370A31 | CAPACITOR | .1UF-20-50 |
| C 305 | 1 | 21-80370A31 | CAPACITOR | .1UF-20-50 |
| C 306 | 1 | 21-80370A31 | CAPACITOR | .1UF-20-50 |
| C 307 | 1 | 23-80369A75 | CAPACITOR | 150UF-50V |
| C 308 | 1 | 21-80370A31 | CAPACITOR | .1UF-20-50 |
| C 309 | 1 | 21-80370A31 | CAPACITOR | .1UF-20-50 |
| C 310 | 1 | 21-80396A52 | CAPACITOR | .01UF-20+80-200 |
| C 311 | 1 | 23D83441B15 | CAPACITOR | 1.0UF-20-35 |
| C 312 | 1 | 21-80396A52 | CAPACITOR | .01UF-20+80-200 |
| C 313 | 1 | 21-80396A52 | CAPACITOR | .01UF-20+80-200 |
| C 314 | 1 | 21-80370A31 | CAPACITOR | .1UF-20-50 |
| C 315 | 1 | 21-80396A52 | CAPACITOR | .01UF-20+80-200 |
| C 316 | 1 | 21-80370A06 | CAPACITOR | .22UF-10-50 |
| C 317 | 1 | 21-80370A31 | CAPACITOR | .1UF-20-50 |
| C 318 | 1 | 21D82428B36 | CAPACITOR | .002UF-10-200 |
| C 319 | 1 | 2C3725U105Z050B | CAPACITOR | 1UF-20+80-50 |
| C 320 | 1 | 21-80370A31 | CAPACITOR | .1UF-20-50 |
| C 321 | 1 | 21-80370A31 | CAPACITOR | .1UF-20-50 |
| C 322 | 1 | 21-80396A51 | CAPACITOR | 1000PF-10-100 |
| C 323 | 1 | 23-80369A72 | CAPACITOR | 10UF-50V |
| C 324 | 1 | 21-80370A31 | CAPACITOR | .1UF-20-50 |
| C 325 | 1 | 21-80370A31 | CAPACITOR | .1UF-20-50 |
| C 326 | 1 | 21-80370A31 | CAPACITOR | .1UF-20-50 |
| C 327 | 1 | 21-80370A31 | CAPACITOR | .1UF-20-50 |
| C 328 | 1 | 21D82428B10 | CAPACITOR | 3300PF-10-100 |
| C 329 | 1 | 23D83441B18 | CAPACITOR | 4.7UF-20-20 |
| C 330 | 1 | 23D84762H14 | CAPACITOR | .47UF-20-50 |
| CR301 | 1 | 48-80345A68 | DIODE | 50V-1A |
| CR302 | 1 | 48-84463K02 | DIODE | |
| CR303 | 1 | 48-84463K02 | DIODE | |
| CR304 | 1 | 48-80345A68 | DIODE | 50V-1A |
| CR305 | 1 | 48-80345A68 | DIODE | 50V-1A |
| L 301 | 1 | 24C83961B01 | CHOKE,RF | |
| L 302 | 1 | 24-84309A90 | INDUCTOR | 100UH |
| L 303 | 1 | 24C83961B01 | CHOKE,RF | |
| L 304 | 1 | 24C83961B01 | CHOKE,RF | |
| L 305 | 1 | 24C83961B01 | CHOKE,RF | |
| L 306 | 1 | 24C83961B01 | CHOKE,RF | |
| L 307 | 1 | 24C83961B01 | CHOKE,RF | |
| L 308 | 1 | 24C83961B01 | CHOKE,RF | |
| L 309 | 1 | 24C83961B01 | CHOKE,RF | |
| L 310 | 1 | 24C83961B01 | CHOKE,RF | |
| L 311 | 1 | 24C83961B01 | CHOKE,RF | |
| Q 301 | 1 | 48-80368A91 | TRANSISTOR | MPS6520 SCREENED |
| Q 302 | 1 | 48-80368A91 | TRANSISTOR | MPS6520 SCREENED |
| Q 303 | 1 | 48-80368A87 | TRANSISTOR | |
| Q 304 | 1 | 48-80368A88 | TRANSISTOR | |
| Q 305 | 1 | 48-80368A91 | TRANSISTOR | MPS6520 SCREENED |
| Q 306 | 1 | 48-80368A92 | TRANSISTOR | MPS6519 SCREENED |
| Q 307 | 1 | 48-80368A91 | TRANSISTOR | MPS6520 SCREENED |
| Q 308 | 1 | 48-80345A41 | TRANSISTOR | |
| Q 309 | 1 | 48-80368A87 | TRANSISTOR | |
| Q 310 | 1 | 48-80368A91 | TRANSISTOR | MPS6520 SCREENED |
| R 301 | 1 | 6S124A49 | RESISTOR | 1K-5-1/4 |
| R 302 | 1 | 6S124A49 | RESISTOR | 1K-5-1/4 |
| R 303 | 1 | 6S124A73 | RESISTOR | 10K-5-1/4 |
| R 304 | 1 | 6S124A45 | RESISTOR | 680-5-1/4 |
| R 305 | 1 | 6S124A65 | RESISTOR | 4.7K-5-1/4 |
| R 306 | 1 | 6S124A73 | RESISTOR | 10K-5-1/4 |
| R 307 | 1 | 6S124A79 | RESISTOR | 18K-5-1/4 |
| R 308 | 1 | 6S124A33 | RESISTOR | 220-5-1/4 |
| R 309 | 1 | 6S124A89 | RESISTOR | 47K-5-1/4 |
| R 310 | 1 | 6S124A73 | RESISTOR | 10K-5-1/4 |
| R 311 | 1 | 6S124A49 | RESISTOR | 1K-5-1/4 |
| R 312 | 1 | 6S124A59 | RESISTOR | 2.7K-5-1/4 |
| R 313 | 1 | 6S124A73 | RESISTOR | 10K-5-1/4 |
| R 314 | 1 | 6S124A90 | RESISTOR | 51K-5-1/4 |
| R 315 | 1 | 18D83452F11 | RESISTOR,VARIABLE | 5K |
| R 316 | 1 | 6S124A59 | RESISTOR | 2.7K-5-1/4 |
| R 317 | 1 | 6S124A89 | RESISTOR | 47K-5-1/4 |
| R 318 | 1 | 6S124B11 | RESISTOR | 360K-5-1/4 |
| R 319 | 1 | 6S124B11 | RESISTOR | 360K-5-1/4 |
| R 320 | 1 | 18D83452F11 | RESISTOR,VARIABLE | 5K |
| R 321 | 1 | 6S124A73 | RESISTOR | 10K-5-1/4 |
| R 322 | 1 | 6S124A89 | RESISTOR | 47K-5-1/4 |
| R 323 | 1 | 6S124A65 | RESISTOR | 4.7K-5-1/4 |
| R 324 | 1 | 6S124A49 | RESISTOR | 1K-5-1/4 |
| R 325 | 1 | 6S124A73 | RESISTOR | 10K-5-1/4 |
| R 326 | 1 | 6S124A44 | RESISTOR | 620-5-1/4 |
| R 327 | 1 | 6S124A89 | RESISTOR | 47K-5-1/4 |
| R 328 | 1 | 18D83452F11 | RESISTOR,VARIABLE | 5K |
| R 329 | 1 | 6S124A92 | RESISTOR | 62K-5-1/4 |
| R 330 | 1 | 06D83175C12 | RESISTOR | 13K-1-1/4 |
| R 331 | 1 | 6S124A01 | RESISTOR | 10-5-1/4 |
| R 332 | 1 | 6S124A73 | RESISTOR | 10K-5-1/4 |
| R 333 | 1 | 6S124A35 | RESISTOR | 270-5-1/4 |
| R 334 | 1 | 6S124B30 | RESISTOR | 2.2M-5-1/4 |
| R 335 | 1 | 6S125A33 | RESISTOR | 220-5-1/2 |
| R 336 | 1 | 6S125A33 | RESISTOR | 220-5-1/2 |
| R 337 | 1 | 6S124A03 | RESISTOR | 12-5-1/4 |
| R 338 | 1 | 6S124A56 | RESISTOR | 2000-5-1/4 |
| R 339 | 1 | 6S124A73 | RESISTOR | 10K-5-1/4 |
| R 340 | 1 | 6S124A63 | RESISTOR | 3900-5-1/4 |
| R 341 | 1 | 6S124A95 | RESISTOR | 82K-5-1/4 |
| R 342 | 1 | 6S124A73 | RESISTOR | 10K-5-1/4 |
| R 343 | 1 | 6S124A31 | RESISTOR | 180-5-1/4 |
| R 344 | 1 | 6S124A73 | RESISTOR | 10K-5-1/4 |
| S 301 | 1 | 40-80369A06 | SWITCH,THERMAL | 85 DEG C |
| TP301 | 1 | 09-80331A88 | JACK,TIP | WHT |
| TP302 | 1 | 09-80331A88 | JACK,TIP | WHT |
| TP303 | 1 | 09-80331A88 | JACK,TIP | WHT |
| TP304 | 1 | 09-80331A88 | JACK,TIP | WHT |
| TP305 | 1 | 09-80331A88 | JACK,TIP | WHT |
| TP306 | 1 | 09-80331A88 | JACK,TIP | WHT |
| TP307 | 1 | 09-80331A88 | JACK,TIP | WHT |
| U 301 | 1 | 51-80345A08 | INTEGRATED CIRCUIT | LM341P-8.0 SCREENI |
| U 302 | 1 | 51-80345A02 | INTEGRATED CIRCUIT | CA3160E SCREENED |
| U 303 | 1 | 51-80368A68 | INTEGRATED CIRCUIT | LM311P SCREENED |
| U 304 | 1 | 51-80345A02 | INTEGRATED CIRCUIT | CA3160E SCREENED |
| U 305 | 1 | 51-80368A32 | INTEGRATED CIRCUIT | MC14011BCP SCREE |
| U 306 | 1 | 51-80345A24 | INTEGRATED CIRCUIT | MC3420P SCREENED |
| VR301 | 1 | 48-86850C95 | DIODE,ZENER | 20V-5-5 |
| VR302 | 1 | 48-82256C38 | DIODE,ZENER | 9.1V |
| VR303 | 1 | 48-818459 | DIODE,ZENER | 6.8V |
| VR304 | 1 | 48-818459 | DIODE,ZENER | 6.8V |
| VR305 | 1 | 48-82256C25 | DIODE,ZENER | 12V-5-1/2 |

Figure 7-13. Low Voltage Power Supply Control Module A1A3 (RTP-4012A) Parts Location Diagram (Sheet 2 of 2)

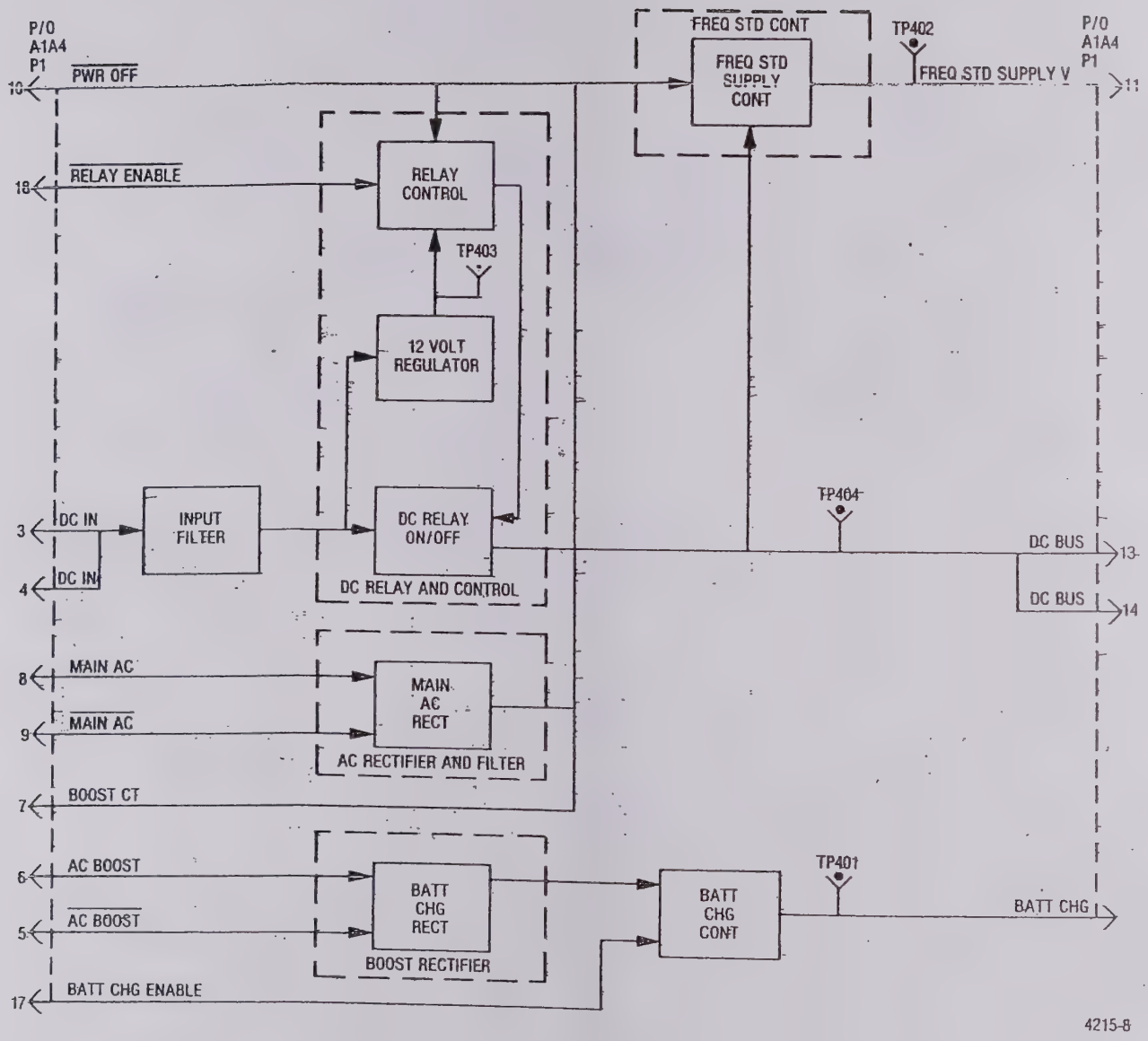



Figure 7-14. Low Voltage Power Supply Relay Module A1A4 Block Diagram

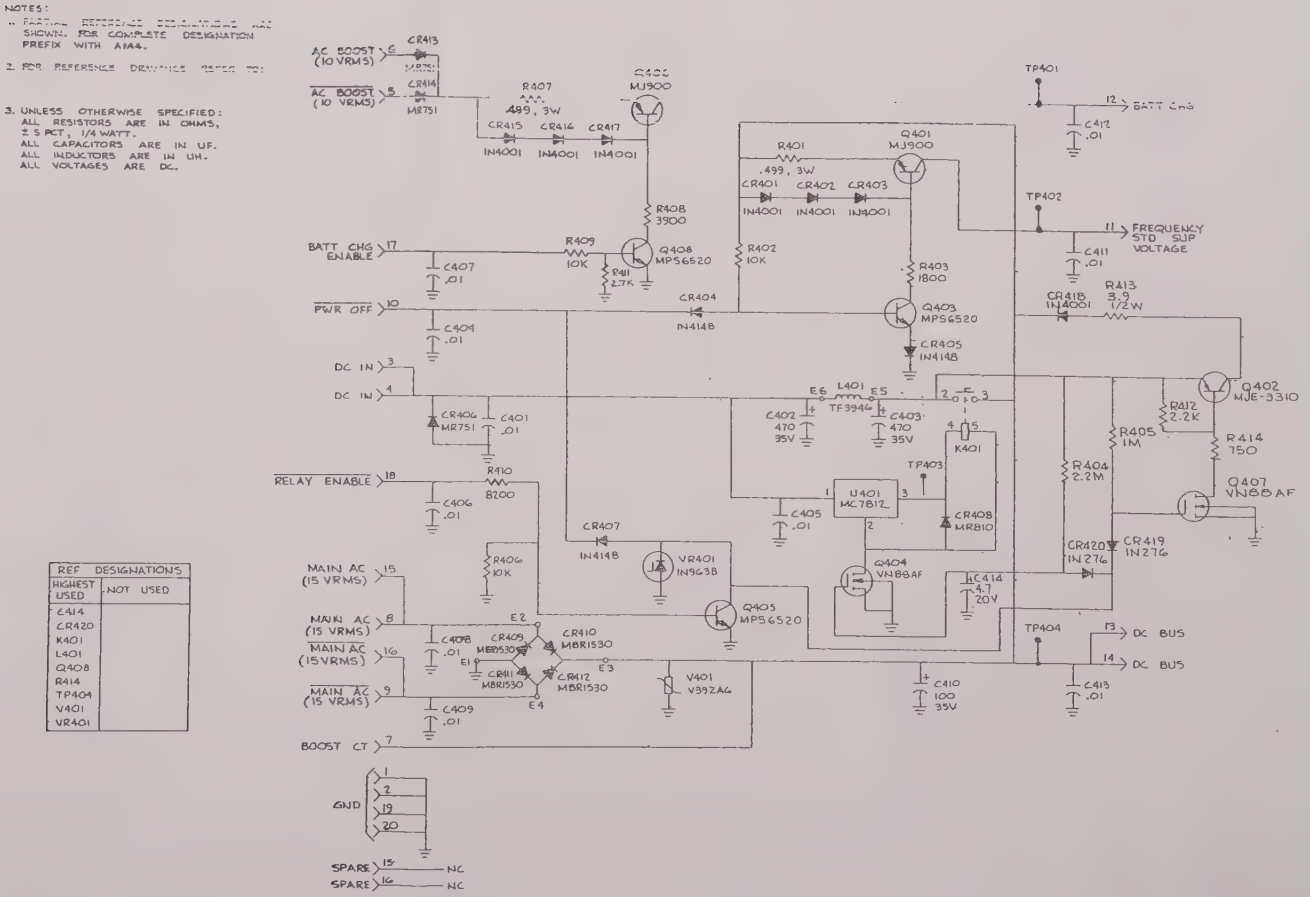



Figure 7-15. Low Voltage Power Supply Relay Module A1A4 Schematic Diagram

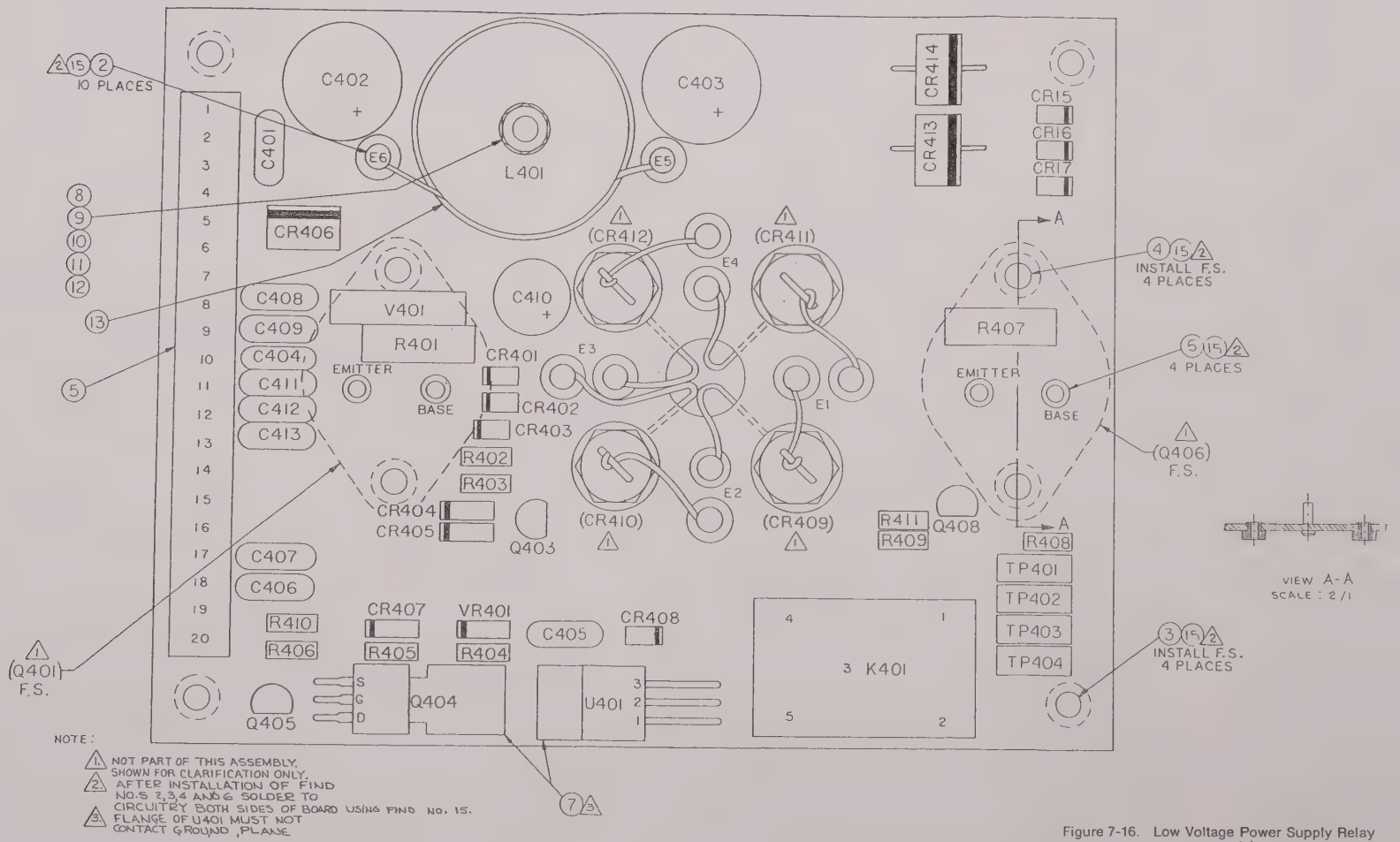


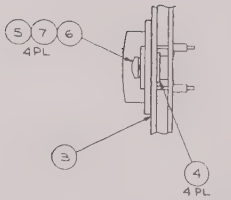

Figure 7-16. Low Voltage Power Supply Relay Module A1A4 (01-80305A68) Parts Location Diagram (Sheet 1 of 3)

| Find No. | Qty. Req. | Part No. | Nomenclature | Part Value |
|---|---|---|---|---|
| 001 | 1 | 84-P07866V001 | PRINTED WIRING BOA | |
| 002 | 10 | 1S6-17-B-20 | TERMINAL | |
| 003 | 4 | B1534-B-1/8-5 | STANDOFF,THREADED | |
| 004 | 4 | B1534-B-3/32-5 | STANDOFF,THREADED | |
| 005 | 1 | 2-87988-0 | CONNECTOR | |
| 006 | 4 | 640206-1 | JACK,PRINTED CIRCU | |
| 008 | 1 | 5607-65 | WASHER,SHOULDER | |
| 009 | 1 | MS35206-232 | SCREW,PH | .1380-32X.750 |
| 010 | 1 | MS35338-41 | WASHER,LOCK | .138 |
| 011 | 1 | MS27183-5 | WASHER,FLAT | .156 |
| 012 | 1 | MS35649-262 | NUT,HEX | .1380-32 |
| 013 | 1 | 14-80370A48 | INSULATOR,INDUCTOR | |
| 014 | AR | SN63WRP3 | SOLDER | |
| 015 | AR | SNS6WRMAP3 | SOLDER | |
| 016 | AR | M81822/6-A20-9 | WIRE,SOLID | #20 WHT,TEF |
| 017 | 1 | 5610-22-31 | WASHER,PLAIN NYLON | NO.10 |
| C 401 | 1 | 21-80396A52 | CAPACITOR | .01UF-20+80-200 |
| C 402 | 1 | 23-80369A78 | CAPACITOR | 470UF-35V |
| C 403 | 1 | 23-80369A78 | CAPACITOR | 470UF-35V |
| C 404 | 1 | 21-80396A52 | CAPACITOR | .01UF-20+80-200 |
| C 405 | 1 | 21-80396A52 | CAPACITOR | .01UF-20+80-200 |
| C 406 | 1 | 21-80396A52 | CAPACITOR | .01UF-20+80-200 |
| C 407 | 1 | 21-80396A52 | CAPACITOR | .01UF-20+80-200 |
| C 408 | 1 | 21-80396A52 | CAPACITOR | .01UF-20+80-200 |
| C 409 | 1 | 21-80396A52 | CAPACITOR | .01UF-20+80-200 |
| C 410 | 1 | 23-80369A73 | CAPACITOR | 100UF-35V |
| C 411 | 1 | 21-80396A52 | CAPACITOR | .01UF-20+80-200 |
| C 412 | 1 | 21-80396A52 | CAPACITOR | .01UF-20+80-200 |
| C 413 | 1 | 21-80396A52 | CAPACITOR | .01UF-20+80-200 |
| C 414 | 1 | 23D83441B18 | CAPACITOR | 4.7UF-20-20 |
| CR401 | 1 | 48-86850C47 | DIODE | |
| CR402 | 1 | 48-86850C47 | DIODE | |
| CR403 | 1 | 48-86850C47 | DIODE | |
| CR404 | 1 | 48-84463K02 | DIODE | |
| CR405 | 1 | 48-84463K02 | DIODE | |
| CR406 | 1 | 48-80345A67 | DIODE | 100V |
| CR407 | 1 | 48-83192A09 | DIODE | |
| CR408 | 1 | 48-80345A68 | DIODE | 50V-1A |
| CR413 | 1 | 48-80345A67 | DIODE | 100V |
| CR414 | 1 | 48-80345A67 | DIODE | 100V |
| CR415 | 1 | 48-86850C47 | DIODE | |
| CR416 | 1 | 48-86850C47 | DIODE | |
| CR417 | 1 | 48-86850C47 | DIODE | |
| CR418 | 1 | 48-86850C47 | DIODE | |
| CR419 | 1 | 48-83192A09 | DIODE | |
| CR420 | 1 | 48-83192A09 | DIODE | |
| K 401 | 1 | 80-80370A56 | RELAY | |
| L 401 | 1 | 24-80369A57 | CHOKE | |
| Q 402 | 1 | 48-80396A24 | TRANSISTOR | |
| Q 403 | 1 | 48-80368A91 | TRANSISTOR | MPS6520 SCREENED |
| Q 404 | 1 | 48-80345A58 | TRANSISTOR | VN88AF SCREENED |
| Q 405 | 1 | 48-80368A91 | TRANSISTOR | MPS6520 SCREENED |
| Q 407 | 1 | 48-80345A58 | TRANSISTOR | VN88AF SCREENED |

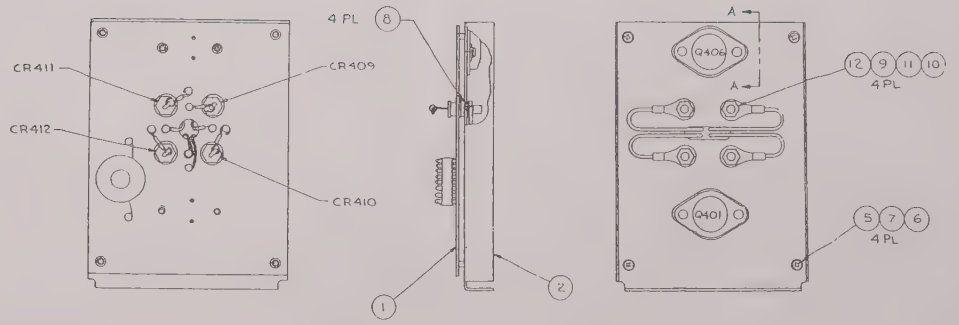
| Find No. | Qty. Req. | Part No. | Nomenclature | Part Value |
|---|---|---|---|---|
| Q 408 | 1 | 48-80368A91 | TRANSISTOR | MPS6520 SCREENED |
| R 401 | 1 | 06-80370A44 | RESISTOR | .499-1-3 |
| R 402 | 1 | 6S124A73 | RESISTOR | 10K-5-1/4 |
| R 403 | 1 | 6S124A55 | RESISTOR | 1.8K-5-1/4 |
| R 404 | 1 | 6S124B30 | RESISTOR | 2.2M-5-1/4 |
| R 405 | 1 | 6S124B22 | RESISTOR | 1M-5-1/4 |
| R 406 | 1 | 6S124A73 | RESISTOR | 10K-5-1/4 |
| R 407 | 1 | 06-80370A44 | RESISTOR | .499-1-3 |
| R 408 | 1 | 6S124A63 | RESISTOR | 3.9K-5-1/4 |
| R 409 | 1 | 6S124A73 | RESISTOR | 10K-5-1/4 |
| R 410 | 1 | 6S124A71 | RESISTOR | 8.2K-5-1/4 |
| R 411 | 1 | 6S124A59 | RESISTOR | 2.7K-5-1/4 |
| R 412 | 1 | 6S124A57 | RESISTOR | 2.2K-5-1/4 |
| R 413 | 1 | 6S125B59 | RESISTOR | 3.9-5-1/2 |
| R 414 | 1 | 6S124A46 | RESISTOR | 750-5-1/4 |
| TP401 | 1 | 09-80331A88 | JACK,TIP | WHT |
| TP402 | 1 | 09-80331A88 | JACK,TIP | WHT |
| TP403 | 1 | 09-80331A88 | JACK,TIP | WHT |
| TP404 | 1 | 09-80331A88 | JACK,TIP | WHT |
| U 401 | 1 | 51-80368A67 | INTEGRATED CIRCUIT | MC7812CT SCREENED |
| V 401 | 1 | 06-80346A21 | VARISTOR | |
| VR401 | 1 | 48-82256C25 | DIODE,ZENER | 12V-5-1/2 |

Figure 7-16. Low Voltage Power Supply Relay Module A1A4 (01-80305A68) Parts Location Diagram (Sheet 2 of 3)

| Find No. | Qty. Req. | Part No. | Nomenclature | Part Value |
|---|---|---|---|---|
| 001 | 1 | 01-80305A67 | RELAY PWB ASSEMBLY | |
| 002 | 1 | 64-P07868V001 | PLATE,MOUNTING,REL | |
| 003 | 2 | M38527/8-03P | INSULATOR,PLATE,FI | TO-3 |
| 004 | 4 | 5607-171 | WASHER,SHOULDER | |
| 005 | 8 | MS35206-215 | SCREW,PH | .1120-40X.375 |
| 006 | 8 | 04-7607 | WASHER,FLAT | .125 |
| 007 | 8 | 04-114583 | WASHER,LOCK | .112 |
| 008 | 2 | M38527/8-76P | INSULATOR,PLATE,FI | STUD MT |
| 009 | 4 | B-225-10X | TERMIAL,CRIMP INSU | #10 |
| 010 | 4 | B51568F015 | NUT,HEX | 10-32 |
| 011 | 4 | B51566F020 | WASHER,LOCK | NO.10 |
| 012 | 4 | 5607-99 | WASHER,SHOULDER | |
| 013 | AR | | WIRE,ELEC | #15 WHT |
| 014 | AR | SN63WRP3 | SOLDER | |
| 015 | AR | 11-14167A01 | INK | BLACK |
| CR409 | 1 | 48-80345A66 | DIODE | |
| CR410 | 1 | 48-80345A66 | DIODE | |
| CR411 | 1 | 48-80345A66 | DIODE | |
| CR412 | 1 | 48-80345A66 | DIODE | |
| Q 401 | 1 | 48-80368A89 | TRANSISTOR | |
| Q 406 | 1 | 48-80368A89 | TRANSISTOR | |




SECTION A-A
SCALE: 2/1
(Q401 AND Q406)




Low Voltage Power Supply Relay
End Plate Assembly

Figure 7-16. Low Voltage Power Supply Relay Module A1A4 (01-80305A68) Parts Location Diagram (Sheet 3 of 3)

# SECTION 8
# SCOPE AMPLIFIER (A2)

**8-1. General.** The Scope Amplifier module contains the horizontal and vertical deflection amps, the horizontal timebase generator, focus and intensity control circuitry, and miscellaneous CRT bias adjustments. A block diagram of the Scope Amplifier module is shown in figure 8-1 with its schematic shown in figure 8-2.

**8-2. Deflection Amplifiers.** The vertical and horizontal deflection amplifiers are identical. The input signal is initially amplified and split into two signals 180° out of phase. Each of the two signals is then further amplified to become the CRT deflection plate signals. The amplifiers provide up to 200 volts peak-peak signal capability with a 1 MHz frequency bandwidth.

**8-3. Horizontal Timebase Generator.** The horizontal timebase generator provides calibrated sweep rates over a six decade range from 1 $\mu$sec to 100 msec per division. Sweep rate selection is from the processor via the SCOPE SWP CONT 0-7 signal lines. Vernier control over the sweep rate is via the SWP VERN VOLT input from the front panel. Sweep triggering is either the auto or normal mode as selected by the AUTO/NOR TRIG SEL line from the front panel. In the auto mode, if the SYNC PRESENT input is high indicating no sync, the scope sweep is self triggered after a hold off time. If there is a sync present, the sweep will wait for a pulse on the TRIG PULSE line to start the sweep after the hold off time. For the normal trigger mode the sweep will always wait for a TRIG PULSE input.

8-4. A sweep cycle consists of two parts, the sweep and the hold off. During the sweep the CRT is unblanked via the SWP BLANKING line and the horizontal trace is made. At the end of the sweep the CRT is blanked and the hold off time begins. During the hold off time, which is equal to the sweep time, the sweep generator and trigger circuits are reset in preparation for the next sweep.

**See "CAUTION" note on page 4-19**

**8-5. Horizontal Switching.** The input to the horizontal deflection amp is selected between two sources. The INT HORIZ IN signal line provides the horizontal character sweep and the horizontal spectrum analyzer sweep. The other source is the scope mode signal path from the horizontal positioning summing amp. The scope mode signal is either the output of the Horizontal Timebase Generator or the EXT HORIZ INPUT from the front panel. Selection between internal horizontal and scope mode horizontal inputs is via the SCOPE MODE EN line from the processor. Selection between the two scope mode signals is via the EXT HORIZ EN line.

**8-6. Intensity Control.** A crossover network is used to provide CRT Z-axis modulation from DC to 1 MHz. The INTEN LVL signal from the front panel control is gated with the SCOPE Z-AXIS signal by the intensity Level Gate. The gated signal is summed with the HV REF and INTEN SMPL VOLT signals to provide the INTEN TV signal. The INTEN TV (Intensity Tracking Voltage) is the low frequency control path which drives the intensity optoisolator in the High Voltage Supply.

8-7. The high frequency modulation path is via the Z-Axis Modulator circuit. The resulting CRT Z-AXIS signal is capacitively coupled to the CRT grid.

**8-8. Focus Control.** The FOCUS TV (Focus Tracking Voltage) signal is obtained by comparing the FOCUS LEVEL control line to the FOCUS SAMPLE VOLT signal. The tracking voltage signal drives an optoisolator circuit in the High Voltage Supply which controls the CRT focus voltage.

**8-9. Astigmatism, Geometry, and Trace Rotation.** These three CRT alignment controls are obtained from the respective wipers of three potentiometers. Each potentiometer is connected between supply voltages equal to the adjustment range required.

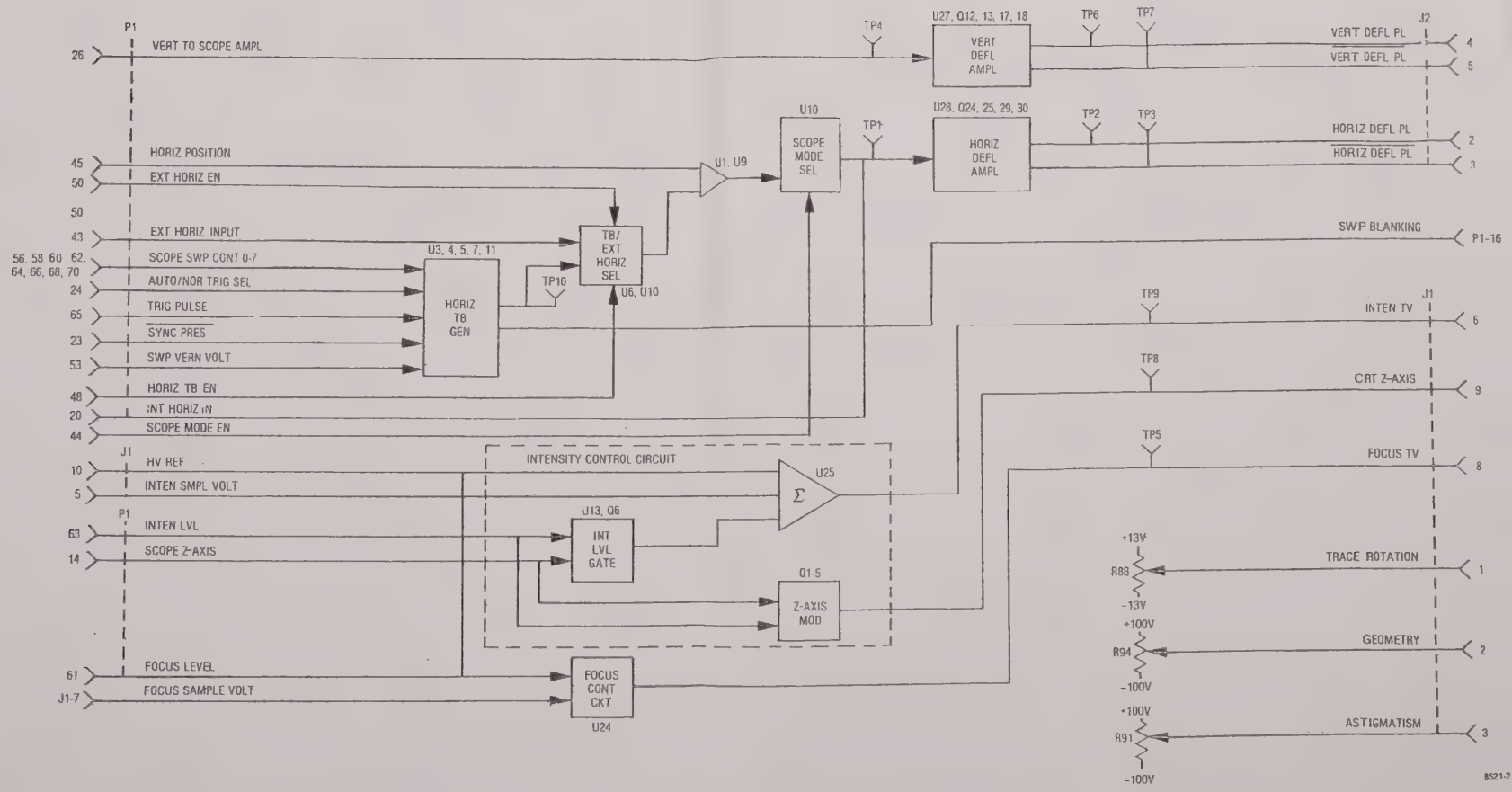



Figure 8-1. Vertical/Horizontal Scope Amplifier A2 Block Diagram

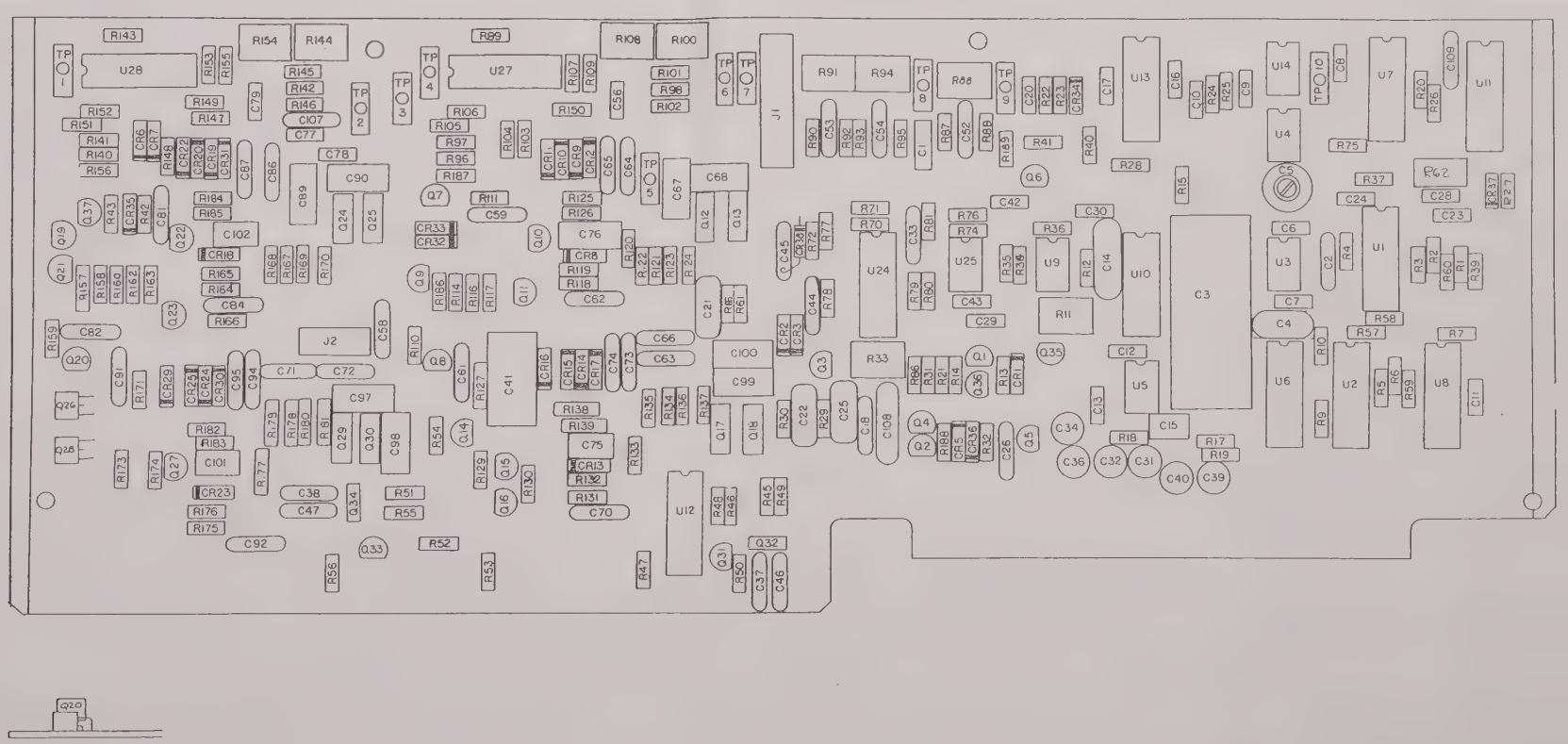



Figure 8-3. Vertical/Horizontal Scope Amplifier Module A2 (RTC-4007B) Parts Location

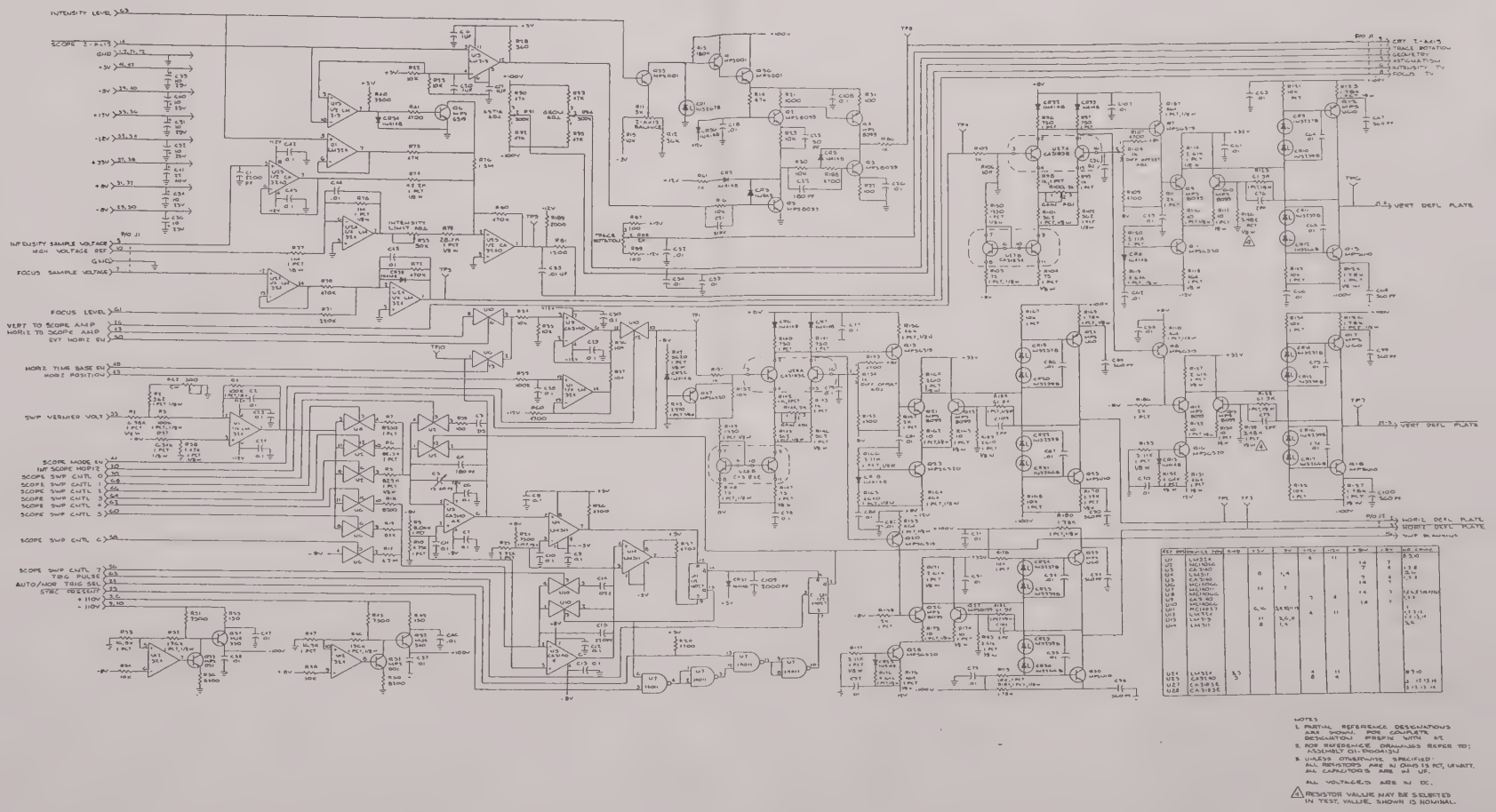


Figure 8-2. Vertical/Horizontal Scope Amplifier A2 Schematic Diagram

| Ref. No. | Qty. Req. | Part No. | Nomenclature | Part Value |
|---|---|---|---|---|
| | | RTC-4007B | SCOPE AMPLIFIER | |
| 001 | 1 | 84-80335A14 | PWB,SCOPE HORIZ/VE | |
| 002 | AR | SN63WRMAP3 | SOLDER | |
| 003 | AR | 11-14167A01 | INK | BLACK |
| 004 | 4 | 26-80346A44 | HEAT SINK,TRANSIST | |
| 005 | 3 | 42-P00317N001 | BLOCK,TRANSISTOR M | |
| 006 | 8 | NAS662-2-4 | SCREW | 2-56X1/4 |
| 007 | 4 | MS35206-215 | SCREW | 4-40X 375 |
| 008 | 4 | 04-114583 | WASHER,LOCK | 112 |
| 009 | 4 | 02-7019 | NUT | 1120-40 |
| 010 | 4 | 33-14232A10 | IDENTIFICATION PLA | |
| 012 | 10 | 09-80331A88 | JACK,TIP | WHT |
| 013 | AR | RTV3140 | COATING,SILICONE | |
| 014 | 1 | 42-P00317N002 | BLOCK,TRANSISTOR M | |
| C 001 | 1 | 08C82789H01 | CAPACITOR | 0022UF-5-50 |
| C 002 | 1 | 21-80396A52 | CAPACITOR | 01UF-20+80-200 |
| C 003 | 1 | 08-83445B68 | CAPACITOR | .215UF-1 |
| C 004 | 1 | 21D84494B46 | CAPACITOR | 180PF-3-500 |
| C 005 | 1 | 20C82399D07 | CAPACITOR,VARIABLE | 15-60PF |
| C 006 | 1 | 21-80396A49 | CAPACITOR | .1UF-20-100 |
| C 007 | 1 | 21-80396A49 | CAPACITOR | 1UF-20-100 |
| C 008 | 1 | 21-80396A49 | CAPACITOR | .1UF-20-100 |
| C 009 | 1 | 21-80396A49 | CAPACITOR | 1UF-20-100 |
| C 010 | 1 | 21-80396A49 | CAPACITOR | 1UF-20-100 |
| C 011 | 1 | 21-80396A49 | CAPACITOR | 1UF-20-100 |
| C 012 | 1 | 21-80396A49 | CAPACITOR | .1UF-20-100 |
| C 013 | 1 | 21-80396A49 | CAPACITOR | 1UF-20-100 |
| C 014 | 1 | 08082096J08 | CAPACITOR | .022UF-10-250 |
| C 015 | 1 | 21D82187B08 | CAPACITOR | 220PF-10-500 |
| C 016 | 1 | 21-80396A49 | CAPACITOR | 1UF-20-100 |
| C 017 | 1 | 21-80396A49 | CAPACITOR | 1UF-20-100 |
| C 018 | 1 | 21-80396A52 | CAPACITOR | .01UF-20+80-200 |
| C 020 | 1 | 21-80396A49 | CAPACITOR | 1UF-20-100 |
| C 021 | 1 | 21D84494B01 | CAPACITOR | 51PF-5-500 |
| C 022 | 1 | 21D84494B46 | CAPACITOR | 180PF-3-500 |
| C 023 | 1 | 21-80396A49 | CAPACITOR | .1UF-20-100 |
| C 024 | 1 | 21-80396A49 | CAPACITOR | .1UF-20-100 |
| C 025 | 1 | 21D84494B07 | CAPACITOR | 150PF-5-500 |
| C 026 | 1 | 21-80396A52 | CAPACITOR | 01UF-20+80-200 |
| C 028 | 1 | 21-80396A49 | CAPACITOR | 1UF-20-100 |
| C 029 | 1 | 21-80396A49 | CAPACITOR | 1UF-20-100 |
| C 030 | 1 | 21-80396A49 | CAPACITOR | 1UF-20-100 |
| C 031 | 1 | 23-80396A40 | CAPACITOR | 10UF-25V |
| C 032 | 1 | 23-80396A40 | CAPACITOR | 10UF-25V |
| C 033 | 1 | 21-80396A52 | CAPACITOR | .01UF-20+80-200 |
| C 034 | 1 | 23-80396A40 | CAPACITOR | 10UF-25V |
| C 036 | 1 | 23-80396A40 | CAPACITOR | 10UF-25V |
| C 037 | 1 | 21-80396A52 | CAPACITOR | .01UF-20+80-200 |
| C 038 | 1 | 21-80396A52 | CAPACITOR | .01UF-20+80-200 |
| C 039 | 1 | 23-80396A40 | CAPACITOR | 10UF-25V |
| C 040 | 1 | 23-80396A40 | CAPACITOR | 10UF-25V |
| C 041 | 1 | 23-80396A43 | CAPACITOR | 22UF-40V |
| C 042 | 1 | 21-80396A49 | CAPACITOR | .1UF-20-100 |
| C 043 | 1 | 21-80396A49 | CAPACITOR | 1UF-20-100 |
| C 044 | 1 | 21-80396A52 | CAPACITOR | 01UF-20+80-200 |
| C 045 | 1 | 21-80396A52 | CAPACITOR | 01UF-20+80-200 |
| C 046 | 1 | 21-80396A52 | CAPACITOR | .01UF-20+80-200 |
| C 047 | 1 | 21-80396A52 | CAPACITOR | .01UF-20+80-200 |
| C 052 | 1 | 21-80396A52 | CAPACITOR | 01UF-20+80-200 |
| C 053 | 1 | 21-80396A52 | CAPACITOR | 01UF-20+80-200 |
| C 054 | 1 | 21-80396A52 | CAPACITOR | 01UF-20+80-200 |
| C 056 | 1 | 21-80396A49 | CAPACITOR | 1UF-20-100 |
| C 058 | 1 | 21-80396A52 | CAPACITOR | 01UF-20+80-200 |
| C 059 | 1 | 21-80396A52 | CAPACITOR | 01UF-20+80-200 |
| C 061 | 1 | 21-80396A52 | CAPACITOR | 01UF-20+80-200 |
| C 062 | 1 | 21-80396A52 | CAPACITOR | 01UF-20+80-200 |
| C 063 | 1 | 21-80396A52 | CAPACITOR | 01UF-20+80-200 |
| C 064 | 1 | 21-80396A52 | CAPACITOR | .01UF-20+80-200 |
| C 065 | 1 | 21-80396A52 | CAPACITOR | .01UF-20+80-200 |
| C 066 | 1 | 21-80396A52 | CAPACITOR | .01UF-20+80-200 |
| C 067 | 1 | 21-80396A50 | CAPACITOR | 560PF-10-500 |
| C 068 | 1 | 21-80396A50 | CAPACITOR | 560PF-10-500 |
| C 070 | 1 | 21-80396A52 | CAPACITOR | .01UF-20+80-200 |
| C 071 | 1 | 21-80396A52 | CAPACITOR | .01UF-20+80-200 |
| C 072 | 1 | 21-80396A52 | CAPACITOR | .01UF-20+80-200 |
| C 073 | 1 | 21-80396A52 | CAPACITOR | .01UF-20+80-200 |
| C 074 | 1 | 21-80396A52 | CAPACITOR | .01UF-20+80-200 |
| C 075 | 1 | 21-14032G97 | CAPACITOR | 2PF-.5PF-500 |
| C 076 | 1 | 21-14032G97 | CAPACITOR | 2PF-.5PF-500 |
| C 077 | 1 | 21-80396A49 | CAPACITOR | .1UF-20-100 |
| C 078 | 1 | 21-80396A49 | CAPACITOR | .1UF-20-100 |
| C 079 | 1 | 21-80396A49 | CAPACITOR | .1UF-20-100 |
| C 081 | 1 | 21-80396A52 | CAPACITOR | .01UF-20+80-200 |
| C 082 | 1 | 21-80396A52 | CAPACITOR | .01UF-20+80-200 |
| C 084 | 1 | 21-80396A52 | CAPACITOR | .01UF-20+80-200 |
| C 086 | 1 | 21-80396A52 | CAPACITOR | .01UF-20+80-200 |
| C 087 | 1 | 21-80396A52 | CAPACITOR | .01UF-20+80-200 |
| C 089 | 1 | 21-80396A50 | CAPACITOR | 560PF-10-500 |
| C 090 | 1 | 21-80396A50 | CAPACITOR | 560PF-10-500 |
| C 091 | 1 | 21-80396A52 | CAPACITOR | .01UF-20+80-200 |
| C 092 | 1 | 21-80396A52 | CAPACITOR | .01UF-20+80-200 |
| C 094 | 1 | 21-80396A52 | CAPACITOR | .01UF-20+80-200 |
| C 095 | 1 | 21-80396A52 | CAPACITOR | .01UF-20+80-200 |
| C 097 | 1 | 21-80396A50 | CAPACITOR | 560PF-10-500 |
| C 098 | 1 | 21-80396A50 | CAPACITOR | 560PF-10-500 |
| C 099 | 1 | 21-80396A50 | CAPACITOR | 560PF-10-500 |
| C 100 | 1 | 21-80396A50 | CAPACITOR | 560PF-10-500 |
| C 101 | 1 | 21-14032G97 | CAPACITOR | 2PF-.5PF-500 |
| C 102 | 1 | 21-14032G97 | CAPACITOR | 2PF-.5PF-500 |
| C 107 | 1 | 21-80396A52 | CAPACITOR | .01UF-20+80-200 |
| C 108 | 1 | 21-80370A05 | CAPACITOR | .1UF-10-100 |
| C 109 | 1 | 21D824ZBB36 | CAPACITOR | 2000PF-10-200 |
| CR001 | 1 | 48-80345A85 | DIODE,ZENER | 75V-5-.5 |
| CR002 | 1 | 48-84463K02 | DIODE | |
| CR003 | 1 | 48-80345A95 | DIODE | |
| CR005 | 1 | 48-84463K02 | DIODE | |
| CR006 | 1 | 48-84463K02 | DIODE | |
| CR007 | 1 | 48-84463K02 | DIODE | |
| CR008 | 1 | 48-84463K02 | DIODE | |
| CR009 | 1 | 48-80345A82 | DIODE,ZENER | 33V-5-.5 |
| CR010 | 1 | 48-80345A83 | DIODE,ZENER | 39V-5-.5 |
| CR011 | 1 | 48-80345A83 | DIODE,ZENER | 39V-5-.5 |
| CR012 | 1 | 48-80345A84 | DIODE,ZENER | 68V-5-.5 |
| CR013 | 1 | 48-84463K02 | DIODE | |
| CR014 | 1 | 48-80345A82 | DIODE,ZENER | 33V-5-.5 |
| CR015 | 1 | 48-80345A83 | DIODE,ZENER | 39V-5-.5 |
| CR016 | 1 | 48-80345A83 | DIODE,ZENER | 39V-5-.5 |
| CR017 | 1 | 48-80345A84 | DIODE,ZENER | 68V-5-.5 |
| CR018 | 1 | 48-84463K02 | DIODE | |
| CR019 | 1 | 48-80345A82 | DIODE,ZENER | 33V-5-.5 |
| CR020 | 1 | 48-80345A83 | DIODE,ZENER | 39V-5-.5 |
| CR022 | 1 | 48-80345A83 | DIODE,ZENER | 39V-5-.5 |
| CR023 | 1 | 48-84463K02 | DIODE | |
| CR024 | 1 | 48-80345A82 | DIODE,ZENER | 33V-5-.5 |
| CR025 | 1 | 48-80345A83 | DIODE,ZENER | 39V-5-.5 |
| CR029 | 1 | 48-80345A83 | DIODE,ZENER | 39V-5-.5 |
| CR030 | 1 | 48-80345A84 | DIODE,ZENER | 68V-5-.5 |
| CR031 | 1 | 48-80345A84 | DIODE,ZENER | 68V-5-.5 |
| CR032 | 1 | 48-84463K02 | DIODE | |
| CR033 | 1 | 48-84463K02 | DIODE | |
| CR034 | 1 | 48-84463K02 | DIODE | |
| CR035 | 1 | 48-84463K02 | DIODE | |
| CR036 | 1 | 48-84463K02 | DIODE | |
| CR037 | 1 | 48-84463K02 | DIODE | |
| CR038 | 1 | 48-84463K02 | DIODE | |
| J 001 | 1 | 1-640456-0 | CONNECTOR | |
| J 002 | 1 | 640456-5 | CONNECTOR | |
| Q 001 | 1 | 48-80345A49 | TRANSISTOR | MPS-D01 SCREENED |
| Q 002 | 1 | 48-80345A51 | TRANSISTOR | |
| Q 003 | 1 | 48-80345A51 | TRANSISTOR | |
| Q 004 | 1 | 48-80345A52 | TRANSISTOR | |
| Q 005 | 1 | 48-80345A51 | TRANSISTOR | |
| Q 006 | 1 | 48-80368A92 | TRANSISTOR | MPS6519 SCREENED |
| Q 007 | 1 | 48-80368A92 | TRANSISTOR | MPS6519 SCREENED |
| Q 008 | 1 | 48-80368A92 | TRANSISTOR | MPS6519 SCREENED |
| Q 009 | 1 | 48-80345A51 | TRANSISTOR | |
| Q 010 | 1 | 48-80345A51 | TRANSISTOR | |
| Q 011 | 1 | 48-80368A91 | TRANSISTOR | MPS6520 SCREENED |
| Q 012 | 1 | 48-80341A48 | TRANSISTOR | MPS-U60 SCREENED |
| Q 013 | 1 | 48-80341A47 | TRANSISTOR | MPS-U10 SCREENED |
| Q 014 | 1 | 48-80345A51 | TRANSISTOR | |
| Q 015 | 1 | 48-80345A51 | TRANSISTOR | |
| Q 016 | 1 | 48-80368A91 | TRANSISTOR | MPS6520 SCREENED |
| Q 017 | 1 | 48-80341A48 | TRANSISTOR | MPS-U60 SCREENED |
| Q 018 | 1 | 48-80341A47 | TRANSISTOR | MPS-U10 SCREENED |
| Q 019 | 1 | 48-80368A92 | TRANSISTOR | MPS6519 SCREENED |
| Q 020 | 1 | 48-80368A92 | TRANSISTOR | MPS6519 SCREENED |
| Q 021 | 1 | 48-80345A51 | TRANSISTOR | |
| Q 022 | 1 | 48-80345A51 | TRANSISTOR | |
| Q 023 | 1 | 48-80368A91 | TRANSISTOR | MPS6520 SCREENED |
| Q 024 | 1 | 48-80341A48 | TRANSISTOR | MPS-U60 SCREENED |
| Q 025 | 1 | 48-80341A47 | TRANSISTOR | MPS-U10 SCREENED |
| Q 026 | 1 | 48-80345A51 | TRANSISTOR | |
| Q 027 | 1 | 48-80345A51 | TRANSISTOR | |
| Q 028 | 1 | 48-80368A91 | TRANSISTOR | MPS6520 SCREENED |
| Q 029 | 1 | 48-80341A48 | TRANSISTOR | MPS-U60 SCREENED |
| Q 030 | 1 | 48-80341A47 | TRANSISTOR | MPS-U10 SCREENED |
| Q 031 | 1 | 48-80345A49 | TRANSISTOR | MPS-D01 SCREENED |
| Q 032 | 1 | 48-80345A14 | TRANSISTOR | |
| Q 033 | 1 | 48-80341A46 | TRANSISTOR | MPS-D51 SCREENED |
| Q 034 | 1 | 48-80345A45 | TRANSISTOR | |
| Q 035 | 1 | 48-80345A49 | TRANSISTOR | MPS-D01 SCREEN |
| Q 036 | 1 | 48-80345A49 | TRANSISTOR | MPS-D01 SCREENED |
| Q 037 | 1 | 48-80368A91 | TRANSISTOR | MPS6520 SCREENED |
| R 001 | 1 | 06083175C88 | RESISTOR | 6.98K-1-1/4 |
| R 002 | 1 | 06-10621B70 | RESISTOR | 562-1-1/8 |
| R 003 | 1 | 06-10621D88 | RESISTOR | 100K-1-1/8 |
| R 004 | 1 | 06-10621D88 | RESISTOR | 100K-1-1/8 |
| R 005 | 1 | 06-10621E77 | RESISTOR | 825K-1-1/8 |
| R 006 | 1 | 06083175C74 | RESISTOR | 82.5K-1-1/4 |
| R 007 | 1 | 06082185J25 | RESISTOR | 8.25K-1-1/4 |
| R 009 | 1 | 06083175C90 | RESISTOR | 9.06K-1-1/4 |
| R 010 | 1 | 06083175C97 | RESISTOR | 4.75K-1-1/4 |
| R 011 | 1 | 18083452F11 | RESISTOR,VARIABLE | 5K |
| R 012 | 1 | 6S124A86 | RESISTOR | 36K-5-1/4 |
| R 013 | 1 | 6S124B04 | RESISTOR | 180K-5-1/4 |
| R 014 | 1 | 6S124A89 | RESISTOR | 47K-5-1/4 |
| R 015 | 1 | 6S124A73 | RESISTOR | 10K-5-1/4 |
| R 016 | 1 | 6S124A73 | RESISTOR | 10K-5-1/4 |
| R 017 | 1 | 6S124B38 | RESISTOR | 4.7M-5-1/4 |
| R 018 | 1 | 6S124A71 | RESISTOR | 8.2K-5-1/4 |
| R 019 | 1 | 6S124A95 | RESISTOR | 82K-5-1/4 |
| R 020 | 1 | 6S124A65 | RESISTOR | 4.7K-5-1/4 |
| R 021 | 1 | 6S124A49 | RESISTOR | 1K-5-1/4 |
| R 022 | 1 | 6S124A73 | RESISTOR | 10K-5-1/4 |

Figure 8-3.
Vertical/Horizontal Scope Amplifier Module A2 (RTC-4007B) Parts Location

| Find No. | Qty. Req. | Part No. | Nomenclature | Part Value |
|---|---|---|---|---|
| R 023 | 1 | 6S124A73 | RESISTOR | 10K-5-1/4 |
| R 024 | 1 | 06-10621C79 | RESISTOR | 7500-1-1/8 |
| R 025 | 1 | 06D8218SJ33 | RESISTOR | 3.92K-1-1/4 |
| R 026 | 1 | 6S124A65 | RESISTOR | 4.7K-5-1/4 |
| R 027 | 1 | 6S124A65 | RESISTOR | 4.7K-5-1/4 |
| R 028 | 1 | 6S124A43 | RESISTOR | 560-5-1/4 |
| R 029 | 1 | 6S124A73 | RESISTOR | 10K-5-1/4 |
| R 030 | 1 | 6S124A73 | RESISTOR | 10K-5-1/4 |
| R 031 | 1 | 6S124A25 | RESISTOR | 100-5-1/4 |
| R 032 | 1 | 6S124A25 | RESISTOR | 100-5-1/4 |
| R 033 | 1 | 18D83452F17 | RESISTOR,VARIABLE | 50K |
| R 034 | 1 | 6S124A73 | RESISTOR | 10K-5-1/4 |
| R 035 | 1 | 6S124A73 | RESISTOR | 10K-5-1/4 |
| R 036 | 1 | 6S124A73 | RESISTOR | 10K-5-1/4 |
| R 037 | 1 | 6S124A73 | RESISTOR | 10K-5-1/4 |
| R 039 | 1 | 6S124A97 | RESISTOR | 100K-5-1/4 |
| R 040 | 1 | 6S124A61 | RESISTOR | 3.3K-5-1/4 |
| R 041 | 1 | 6S124A55 | RESISTOR | 4.7K-5-1/4 |
| R 042 | 1 | 06-10621C67 | RESISTOR | 5620-1-1/8 |
| R 043 | 1 | 06-10621C31 | RESISTOR | 2370-1-1/8 |
| R 045 | 1 | 6S124A70 | RESISTOR | 7.5K-5-1/4 |
| R 046 | 1 | 06-10621E17 | RESISTOR | 196K-1-1/8 |
| R 047 | 1 | 06D83175C21 | RESISTOR | 16.9K-1-1/4 |
| R 048 | 1 | 6S124A73 | RESISTOR | 10K-5-1/4 |
| R 049 | 1 | 6S124A29 | RESISTOR | 150-5-1/4 |
| R 050 | 1 | 6S124A71 | RESISTOR | 8.2K-5-1/4 |
| R 051 | 1 | 6S124A70 | RESISTOR | 7.5K-5-1/4 |
| R 052 | 1 | 06-10621E17 | RESISTOR | 196K-1-1/8 |
| R 053 | 1 | 06D83175C21 | RESISTOR | 16.9K-1-1/4 |
| R 054 | 1 | 6S124A73 | RESISTOR | 10K-5-1/4 |
| R 055 | 1 | 6S124A29 | RESISTOR | 150-5-1/4 |
| R 056 | 1 | 6S124A71 | RESISTOR | 8.2K-5-1/4 |
| R 057 | 1 | 06-10621C72 | RESISTOR | 6340-1-1/8 |
| R 058 | 1 | 06-10621C11 | RESISTOR | 1470-1-1/8 |
| R 059 | 1 | 6S124A25 | RESISTOR | 100-5-1/4 |
| R 060 | 1 | 6S124A65 | RESISTOR | 4.7K-5-1/4 |
| R 061 | 1 | 6S124A49 | RESISTOR | 1K-5-1/4 |
| R 062 | 1 | 18D83452F07 | RESISTOR,VARIABLE | 500-20-1/2 |
| R 070 | 1 | 6S124B14 | RESISTOR | 470K-5-1/4 |
| R 071 | 1 | 6S124B06 | RESISTOR | 220K-5-1/4 |
| R 072 | 1 | 6S124B14 | RESISTOR | 470K-5-1/4 |
| R 074 | 1 | 06-10621D52 | RESISTOR | 42.2K-1-1/8 |
| R 075 | 1 | 6S124A89 | RESISTOR | 47K-5-1/4 |
| R 076 | 1 | 6S124B26 | RESISTOR | 1.5M-5-1/4 |
| R 077 | 1 | 06-10621E85 | RESISTOR | 1M-1-1/8 |
| R 078 | 1 | 06-10621E85 | RESISTOR | 1M-1-1/8 |
| R 079 | 1 | 06-10621D36 | RESISTOR | 28.7K-1-1/8 |
| R 080 | 1 | 6S124B14 | RESISTOR | 470K-5-1/4 |
| R 081 | 1 | 6S124A53 | RESISTOR | 1.5K-5-1/4 |
| R 086 | 1 | 6S124A49 | RESISTOR | 1K-5-1/4 |
| R 087 | 1 | 6S124A25 | RESISTOR | 100-5-1/4 |
| R 088 | 1 | 18D83452F01 | RESISTOR,VARIABLE | 2K |
| R 089 | 1 | 6S124A25 | RESISTOR | 100-5-1/4 |
| R 090 | 1 | 6S124A89 | RESISTOR | 47K-5-1/4 |
| R 091 | 1 | 18D83452F23 | RESISTOR,VARIABLE | 500K |
| R 092 | 1 | 6S124A89 | RESISTOR | 47K-5-1/4 |
| R 093 | 1 | 6S124A89 | RESISTOR | 47K-5-1/4 |
| R 094 | 1 | 18D83452F23 | RESISTOR,VARIABLE | 500K |
| R 095 | 1 | 6S124A89 | RESISTOR | 47K-5-1/4 |
| R 096 | 1 | 06D84444A18 | RESISTOR | 750-1-1/4 |
| R 097 | 1 | 06D84444A18 | RESISTOR | 750-1-1/4 |
| R 098 | 1 | 06D84444A64 | RESISTOR | 1K-1-1/4 |
| R 099 | 1 | 06D84444A64 | RESISTOR | 1K-1-1/4 |
| R 100 | 1 | 18D83452F11 | RESISTOR,VARIABLE | 5K |
| R 101 | 1 | 06-10621B70 | RESISTOR | 562-1-1/8 |
| R 102 | 1 | 06-10621B70 | RESISTOR | 562-1-1/8 |
| R 103 | 1 | 06-10621A85 | RESISTOR | 75-1-1/8 |
| R 104 | 1 | 06-10621A85 | RESISTOR | 75-1-1/8 |
| R 105 | 1 | 6S124A49 | RESISTOR | 1K-5-1/4 |
| R 106 | 1 | 6S124A73 | RESISTOR | 10K-5-1/4 |
| R 107 | 1 | 6S124A65 | RESISTOR | 4.7K-5-1/4 |
| R 108 | 1 | 18D83452F09 | RESISTOR,VARIABLE | 1K |
| R 109 | 1 | 6S124A65 | RESISTOR | 4.7K-5-1/4 |
| R 110 | 1 | 06-10621B62 | RESISTOR | 464-1-1/8 |
| R 111 | 1 | 06D82672B62 | RESISTOR | 2K-1-1/4 |
| R 114 | 1 | 06-10621C35 | RESISTOR | 2610-1-1/8 |
| R 116 | 1 | 06-10621A01 | RESISTOR | 10-1-1/8 |
| R 117 | 1 | 06-10621A01 | RESISTOR | 10-1-1/8 |
| R 118 | 1 | 06-10621B62 | RESISTOR | 464-1-1/8 |
| R 119 | 1 | 06-10621C59 | RESISTOR | 4640-1-1/8 |
| R 120 | 1 | 06-10621C63 | RESISTOR | 5110-1-1/8 |
| R 121 | 1 | 06D83175C03 | RESISTOR | 10K-1-1/4 |
| R 122 | 1 | 06D83175C03 | RESISTOR | 10K-1-1/4 |
| R 123 | 1 | 06-10621C19 | RESISTOR | 1780-1-1/8 |
| R 124 | 1 | 06-10621C19 | RESISTOR | 1780-1-1/8 |
| R 125 | 1 | 06-10621D68 | RESISTOR | 61.9K-1-1/8 |
| R 126 | S01 | 06-10621C55 | RESISTOR | 4220-1-1/8 |
| R 126 | S01 | 06-10621C31 | RESISTOR | 2370-1-1/8 |
| R 126 | S01 | 06-10621C35 | RESISTOR | 2610-1-1/8 |
| R 126 | S01 | 06-10621C39 | RESISTOR | 2870-1-1/8 |
| R 126 | S01 | 06-10621C42 | RESISTOR | 3090-1-1/8 |
| R 126 | S01 | 06-10621C43 | RESISTOR | 3160-1-1/8 |
| R 126 | 1 | 06-10621C47 | RESISTOR | 3480-1-1/8 NOMINAL |
| R 126 | S01 | 06-10621C51 | RESISTOR | 3830-1-1/8 |
| R 126 | S01 | 06-10621C53 | RESISTOR | 4020-1-1/8 |
| R 126 | S01 | 06-10621C59 | RESISTOR | 4640-1-1/8 |
| R 126 | S01 | 06-10621C63 | RESISTOR | 5110-1-1/8 |
| R 127 | 1 | 06-10621C35 | RESISTOR | 2610-1-1/8 |
| R 129 | 1 | 06-10621A01 | RESISTOR | 10-1-1/8 |
| R 130 | 1 | 06-10621A01 | RESISTOR | 10-1-1/8 |
| R 131 | 1 | 06-10621B62 | RESISTOR | 464-1-1/8 |
| R 132 | 1 | 06-10621C59 | RESISTOR | 4640-1-1/8 |
| R 133 | 1 | 06-10621C63 | RESISTOR | 5110-1-1/8 |
| R 134 | 1 | 06D83175C03 | RESISTOR | 10K-1-1/4 |
| R 135 | 1 | 06D83175C03 | RESISTOR | 10K-1-1/4 |
| R 136 | 1 | 06-10621C19 | RESISTOR | 1780-1-1/8 |
| R 137 | 1 | 06-10621C19 | RESISTOR | 1780-1-1/8 |
| R 138 | 1 | 06-10621D68 | RESISTOR | 61.9K-1-1/8 |
| R 139 | S01 | 06-10621C55 | RESISTOR | 4220-1-1/8 |
| R 139 | S01 | 06-10621C31 | RESISTOR | 2370-1-1/8 |
| R 139 | S01 | 06-10621C35 | RESISTOR | 2610-1-1/8 |
| R 139 | S01 | 06-10621C39 | RESISTOR | 2870-1-1/8 |
| R 139 | S01 | 06-10621C42 | RESISTOR | 3090-1-1/8 |
| R 139 | S01 | 06-10621C43 | RESISTOR | 3160 1-1/8 |
| R 139 | 1 | 06-10621C47 | RESISTOR | 3480 1-1/8 NOMINAL |
| R 139 | S01 | 06-10621C51 | RESISTOR | 3830-1-1/8 |
| R 139 | S01 | 06-10621C53 | RESISTOR | 4020-1-1/8 |
| R 139 | S01 | 06-10621C59 | RESISTOR | 4640-1-1/8 |
| R 139 | S01 | 06-10621C63 | RESISTOR | 5110-1-1/8 |
| R 140 | 1 | 06D84444A18 | RESISTOR | 750-1-1/4 |
| R 141 | 1 | 06D84444A18 | RESISTOR | 750-1-1/4 |
| R 142 | 1 | 06D84444A64 | RESISTOR | 1K-1-1/4 |
| R 143 | 1 | 06D84444A64 | RESISTOR | 1K-1-1/4 |
| R 144 | 1 | 18D83452F11 | RESISTOR,VARIABLE | 5K |
| R 145 | 1 | 06-10621B70 | RESISTOR | 562-1-1/8 |
| R 146 | 1 | 06-10621B70 | RESISTOR | 562-1-1/8 |
| R 147 | 1 | 06-10621A85 | RESISTOR | 75-1-1/8 |
| R 148 | 1 | 06-10621A85 | RESISTOR | 75-1-1/8 |
| R 149 | 1 | 06-10621C07 | RESISTOR | 1330-1-1/8 |
| R 150 | 1 | 06-10621C07 | RESISTOR | 1330-1-1/8 |
| R 151 | 1 | 6S124A49 | RESISTOR | 1K-5-1/4 |
| R 152 | 1 | 6S124A73 | RESISTOR | 10K-5-1/4 |
| R 153 | 1 | 6S124A65 | RESISTOR | 4.7K-5-1/4 |
| R 154 | 1 | 18D83452F09 | RESISTOR,VARIABLE | 1K |
| R 155 | 1 | 6S124A65 | RESISTOR | 4.7K-5-1/4 |
| R 156 | 1 | 06-10621B62 | RESISTOR | 464-1-1/8 |
| R 157 | 1 | 06D82672B62 | RESISTOR | 2K-1-1/4 |
| R 158 | 1 | 06D82672B62 | RESISTOR | 2K-1-1/4 |
| R 159 | 1 | 06-10621B62 | RESISTOR | 464-1-1/8 |
| R 160 | 1 | 06-10621C35 | RESISTOR | 2610-1-1/8 |
| R 162 | 1 | 06-10621A01 | RESISTOR | 10-1-1/8 |
| R 163 | 1 | 06-10621A01 | RESISTOR | 10-1-1/8 |
| R 164 | 1 | 06-10621B62 | RESISTOR | 464-1-1/8 |
| R 165 | 1 | 06-10621C59 | RESISTOR | 4640-1-1/8 |
| R 166 | 1 | 06-10621C63 | RESISTOR | 5110-1-1/8 |
| R 167 | 1 | 06D83175C03 | RESISTOR | 10K-1-1/4 |
| R 168 | 1 | 06D83175C03 | RESISTOR | 10K-1-1/4 |
| R 169 | 1 | 06-10621C19 | RESISTOR | 1780-1-1/8 |
| R 170 | 1 | 06-10621C19 | RESISTOR | 1780-1-1/8 |
| R 171 | 1 | 06-10621C35 | RESISTOR | 2610-1-1/8 |
| R 173 | 1 | 06-10621A01 | RESISTOR | 10-1-1/8 |
| R 174 | 1 | 06-10621A01 | RESISTOR | 10-1-1/8 |
| R 175 | 1 | 06-10621B62 | RESISTOR | 464-1-1/8 |
| R 176 | 1 | 06-10621C59 | RESISTOR | 4640-1-1/8 |
| R 177 | 1 | 06-10621C63 | RESISTOR | 5110-1-1/8 |
| R 178 | 1 | 06D83175C03 | RESISTOR | 10K-1-1/4 |
| R 179 | 1 | 06D83175C03 | RESISTOR | 10K-1-1/4 |
| R 180 | 1 | 06-10621C19 | RESISTOR | 1780-1-1/8 |
| R 181 | 1 | 06-10621C19 | RESISTOR | 1780-1-1/8 |
| R 182 | 1 | 06-10621D68 | RESISTOR | 61.9K-1-1/8 |
| R 183 | 1 | 06-10621C35 | RESISTOR | 2610-1-1/8 |
| R 184 | 1 | 06-10621D68 | RESISTOR | 61.9K-1-1/8 |
| R 185 | 1 | 06-10621C35 | RESISTOR | 2610-1-1/8 |
| R 186 | 1 | 06D82672B62 | RESISTOR | 2K-1-1/4 |
| R 187 | 1 | 06-10621B62 | RESISTOR | 464-1-1/8 |
| R 188 | 1 | 6S124A65 | RESISTOR | 4.7K-5-1/4 |
| R 189 | 1 | 6S124A56 | RESISTOR | 2.0K-5-1/4 |
| U 001 | 1 | 51-80396A16 | INTEGRATED CIRCUIT | LM324N SCREENED |
| U 002 | 1 | 51-82884L48 | INTEGRATED CIRCUIT | MC14066BCP SCREENE |
| U 003 | 1 | 51-80345A01 | INTEGRATED CIRCUIT | CA3140E SCREENED |
| U 004 | 1 | 51-80368A68 | INTEGRATED CIRCUIT | LM311P SCREENED |
| U 005 | 1 | 51-80345A01 | INTEGRATED CIRCUIT | CA3140E SCREENED |
| U 006 | 1 | 51-82884L48 | INTEGRATED CIRCUIT | MC14066BCP SCREENE |
| U 007 | 1 | 51-80368A32 | INTEGRATED CIRCUIT | MC14011BCP SCREENE |
| U 008 | 1 | 51-82884L48 | INTEGRATED CIRCUIT | MC14066BCP SCREENE |
| U 009 | 1 | 51-80345A01 | INTEGRATED CIRCUIT | CA3140E SCREENED |
| U 010 | 1 | 51-82884L48 | INTEGRATED CIRCUIT | MC14066BCP SCREENE |
| U 011 | 1 | 51-80368A34 | INTEGRATED CIRCUIT | MC14027BCP SCREENE |
| U 012 | 1 | 51-80396A16 | INTEGRATED CIRCUIT | LM324N SCREENED |
| U 013 | 1 | 51-80345A06 | INTEGRATED CIRCUIT | LM319N SCREENED |
| U 014 | 1 | 51-80368A68 | INTEGRATED CIRCUIT | LM311P SCREENED |
| U 024 | 1 | 51-80396A16 | INTEGRATED CIRCUIT | LM324N SCREENED |
| U 025 | 1 | 51-80345A04 | INTEGRATED CIRCUIT | CA3240E SCREENED |
| U 027 | 1 | 51-80345A03 | INTEGRATED CIRCUIT | CA3183E SCREENED |
| U 028 | 1 | 51-80345A03 | INTEGRATED CIRCUIT | CA3183E SCREENED |

Figure 8-3. Vertical/Horizontal Scope Amplifier Module A2 (RTC-4007B) Parts Location Diagram

9-19. The Internal DVM Select switch is followed b

# SECTION 9
# SCOPE/DVM CONTROL MODULE (A3)

**9-1. General.** A primary function of the Scope/DVM Control Module is to route the required measurement and viewing signals to the DVM and scope circuitry. A large portion of the displayed data is determined by the DVM measurements on internal signal points. Thus for a rapid update of several data displays it is necessary to time division multiplex several measurements points to the DVM. The DVM control circuitry and the system processor provide this function.

9-2. The scope control circuitry allows the system to display data information, internal modulation or demodulated signals, and external scope inputs as selected by the user. Provisions are also made for external horizontal inputs and a horizontal sweep that is coherent with the sweep generator for spectrum analyzer and filter alignment displays.

9-3. The control module also contains circuitry for single sideband demodulation and a IF phase locked loop for filtering and waveshaping the IF signal for frequency counting. A block diagram of the Scope/DVM Control module is shown in figure 9-1 with a schematic shown in figure 9-2.

**9-4. Scope Vertical Control.** The input to the scope vertical amplifier is switched between four different sources; the range switch (VERT FROM RNG SW), the vertical character sweep, the spectrum analyzer (SPECT ANA VERT), or the 455 kHz IF. Range switch inputs are from either the scope vertical input jack on the front panel or the internal modulation signals as selected by the modulation display control on this module. The vertical character sweep is a sawtooth waveform generated by the Vertical Character Sweep Generator and synced by the VERT CHAR SYNC signal from the character generator. The detected and amplified output of the receiver logarithimic IF is the vertical input for the spectrum analyzer. The remaining signal source is the second IF signal from the receiver for IF envelope observation.

9-5. For the spectrum analyzer and the scope sweep displays the Dual Display Control and Character Sweep Counter circuitry allow a single row of characters at the top of the CRT. This function is implemented with the Vertical Sweep Control by alternating the spectrum analyzer or the range switch signal with the vertical character sweep signal.

9-6. The dual display sequence of events starts with the Synthesizer Sweep Generator which is common to both display modes. When the synthesizer sweep is near its peak (scope horizontal sweep is at the edge of the screen) the Dual Display Control activates the CHAR GEN RST line and switches the scope vertical and horizontal inputs to their character generator sweeps. When the first character line has been traced, a transition on the $\overline{\text{LINE 1}}$ input from the character generator resets the character generator sweeps and the character generator, increments the Character Sweep Counter, and thus causes line 1 to be traced again. This process repeats until four traces, as counted by the Character Sweep Counter, have been completed. At that point the counter resets the scope inputs back to the spectrum analyzer or range switch input. During the character display time the synthesizer sweep generator is reset and held until a transition on the SYNTH SWP SYNC line restarts the sweep. The timing of the process allows for the four character traces to be completed before the sweep sync occurs.

**9-7. SSB Detection.** Single Sideband (SSB) modulation is recovered by multiplying the 455 kHz IF signal with a 455 kHz beat frequency oscillator (BFO) signal. The BFO is controlled directly from the front panel and is adjustable over a 6 kHz frequency range. SSB AUDIO from the multiplier is routed to the receiver for post detection filtering. A sample of the BFO signal is made available to the frequency counter on the IF/BFO FREQ line for sideband frequency error determination.

**9-8. 455 kHz PLL.** For monitor frequency error determination a 455 kHz Phase Locked Loop (PLL) is used to filter and to shape the IF signal. The cleaned up signal is switched with the BFO signal to the frequency counter.

**9-9. Scope Horizontal Control.** Switching for the scope horizontal input is divided between two modules. The time base generator and the external horizontal input are selected on the scope amplifier module. The Horizontal Character Sweep Generator and the Synthesizer Sweep Generator signals are selected on the Control Module to the INT SCOPE HORIZ signal line.

9-10. For the dual display modes (characters and synthesizer sweep) the Horizontal Switch Control switches the horizontal input between the synthesizer sweep and the character sweep. This switching occurs simultaneously with that occurring in the scope vertical control as described in paragraph 9-6. The Horizontal Switch Control also provides the SCOPE MODE EN line to the scope amplifier to enable the scope mode horizontal inputs.

**9-11. Synthesizer Sweep Control.** The sweep signal generated by the Synthesizer Sweep Generator is controlled in amplitude and in range across the front panel sweep width control. Attenuations of 1.0 or 0.1 are provided by the Sweep Width Select circuitry to the sweep signal at the DISPERSION SWP signal line to the top of the width control. The bottom side of the width control is returned to the Sweep Width Select circuitry via the DISPERSION SWP RTN line. A 10 to 1 resistor change is made in the return line simultaneously with the attenuator change to give sweep ranges of 1-10 MHz and 0.01-1 MHz.

**9-12. Scope Z-Axis Control.** The SCOPE Z-AXIS signal has three possible sources as selected by the Z-Axis Control circuit. For character displays the Z-Axis signal is the CHAR GEN Z-AXIS from the character generator. The SWP BLANKING signal from the horizontal timebase generator is switched to the scope Z-Axis for the scope modes. For the remaining modes, spectrum analyzer and scope sweep, a logic zero level is gated to the Z-Axis input.

**9-13. Modulation Display Control.** Internal modulation or demodulated signals are displayed on the scope by switching the desired signal source to the input ranging switch and then switching the ranging switch output to the scope vertical input. The INTERNAL SCOPE AND PEAK DETECTOR SELECT circuitry switches DEMOD CAL AUDIO or AM CARRIER + MOD LEVEL or MOD CAL AUDIO to the internal scope and the peak detectors. The signals are gain adjusted before exiting the module from the INT SCOPE TO RANGING SWITCH output pin. The gains are processor selected.

9-14. The DEMOD CAL AUDIO signal from the receiver is either AM, FM, or SSB as determined by the operating mode. The peak signal level on this line is calibrated to 10 kHz/volt for FM and 10%/volt for AM. SSB signals are not calibrated.

9-15. For AM the CARRIER + MOD LVL input from the generator output detector provides a direct display of the modulation. This input is a DC level representative of the average output level plus an AC signal representative of the amplitude modulation on the output. For the scope modulation display the DC level is blocked so that only the AC component is observed. This input is uncalibrated for absolute AC levels, but the processor by determining the peak AC and average DC levels can determine the modulation depth.

9-16. For FM the MOD CAL AUDIO input from the audio synthesizer is calibrated to 5 kHz/volt for narrow band and to 20 kHz/volt for wide band. Correspondingly the display calibration attenuator has two gain ranges to maintain the same display calibration for both narrow and wide band.

**9-17. Peak Detector.** Each of the modulation and demodulation inputs can be selected to the peak detecting circuitry for the determination of % AM or kHz deviation. The peak detector circuitry provides DC outputs equal to the negative and positive peak values of the input signal relative to the average DC level of the signal. These levels are then digitized by the DVM and input to the processor where the modulation level is determined.

**9-18. DVM Control.** Any one of nine internal measurement points may be switched to INT DVM TO A/D. This signal is routed to the A7 (processor interface board) where it is multiplexed with external DVM data to the input of the analog to digital (A/D) converter. In general several internal measurement points must be input to the A/D converter to obtain all of the displayed data. Therefore the processor continuously cycles the INTERNAL DVM SELECT through the required measurement points stopping at each one long enough to digitize and input the data to the microprocessor.

9-19. The Internal DVM Select switch is followed by a range attenuator. As the processor cycles through the inputs it sets the range attenuator according to the last cycle reading made at that input. Thus each internal input is auto ranged over two decades to give three digit accuracy up to a maximum input of 10 volts. The internal DVM inputs and their function are listed in table 9-1.

Table 9-1. Internal DVM Inputs

| | |
|---|---|
| + Peak Voltage | Positive modulation measurements |
| − Peak Voltage | Negative modulation measurements |
| Carrier Level | RF output level |
| RF INPUT PWR | Power level applied to the RF input/output port |
| EXT FWD PWR | Forward power level on external inline wattmeter element |
| EXT RFL PWR | Reflected power level on external inline wattmeter element |
| BATT VOLT | Voltage level at DC input jack on the rear panel divided by 10 |
| TEMP SENS VOLT | +5V level signal the processor that the RF load temperature is too high |
| SINAD/DISTORTION IN | DC level proportional to the signal power at the input of the SINAD/DISTORTION NOTCH Filter |

9-21. **External DVM/Distortion Control.** External DVM and distortion inputs to the front panel jack are ranged by microprocessor control over four decades at the A12 (front panel interface) module. The resulting output is routed to the DVM FROM RNG SWITCH input of the A3 module. The signal is input to the DVM/DISTORTION SELECT circuitry and the gain of 6.5 preceding the 1 kHz notch filter.

9-22. **Distortion Measurement.** In the distortion mode the DVM/DISTORTION SELECT circuitry routes the output of the 1 kHz notch filter to the EXT. DVM to A/D output pin where it is connected to the RMS to DC converter on the A7 (processor interface) module. The output of the RMS to DC converter is multiplexed to the A/D and read by the microprocessor. The input to the notch filter is rectified, filtered and applied to the INTERNAL DVM SELECT for reading by the microprocessor (refer to paragraph 9-19). The microprocessor divides the RMS output voltage of the notch filter by the average rectified input voltage to the notch filter to obtain the percent distortion for a 1 kHz input. The notch filter has a microprocessor controlled gain that is switched to either times one or times ten depending on input distortion and signal levels.

9-23. **EXTERNAL DVM MEASUREMENT.** In the external DVM mode the DVM FROM RNG SWITCH input is routed by the DVM/DISTORTION SELECT circuitry directly to the EXT DVM TO A/D output where it is connected to the RMS to DC converter on the A7 (microprocessor interface) module. The output of the RMS to DC converter is multiplexed to the A/D converter where it is read by the microprocessor.

9-24. **Module Control.** Processor control of the Scope/DVM Control module is via the AF ADD BUS 0-3, the AF DATA BUS 0-3, and the AF BUS EN 1 signal lines. The four address bits are decoded by the Address Decode to determine which Control Latch the four bits of data will be latched into. The latching process is synchronized by the enable line. Control latches in addition to those necessary for controlling the module provide control for the Scope Amplifier module and part of the RF Input module.

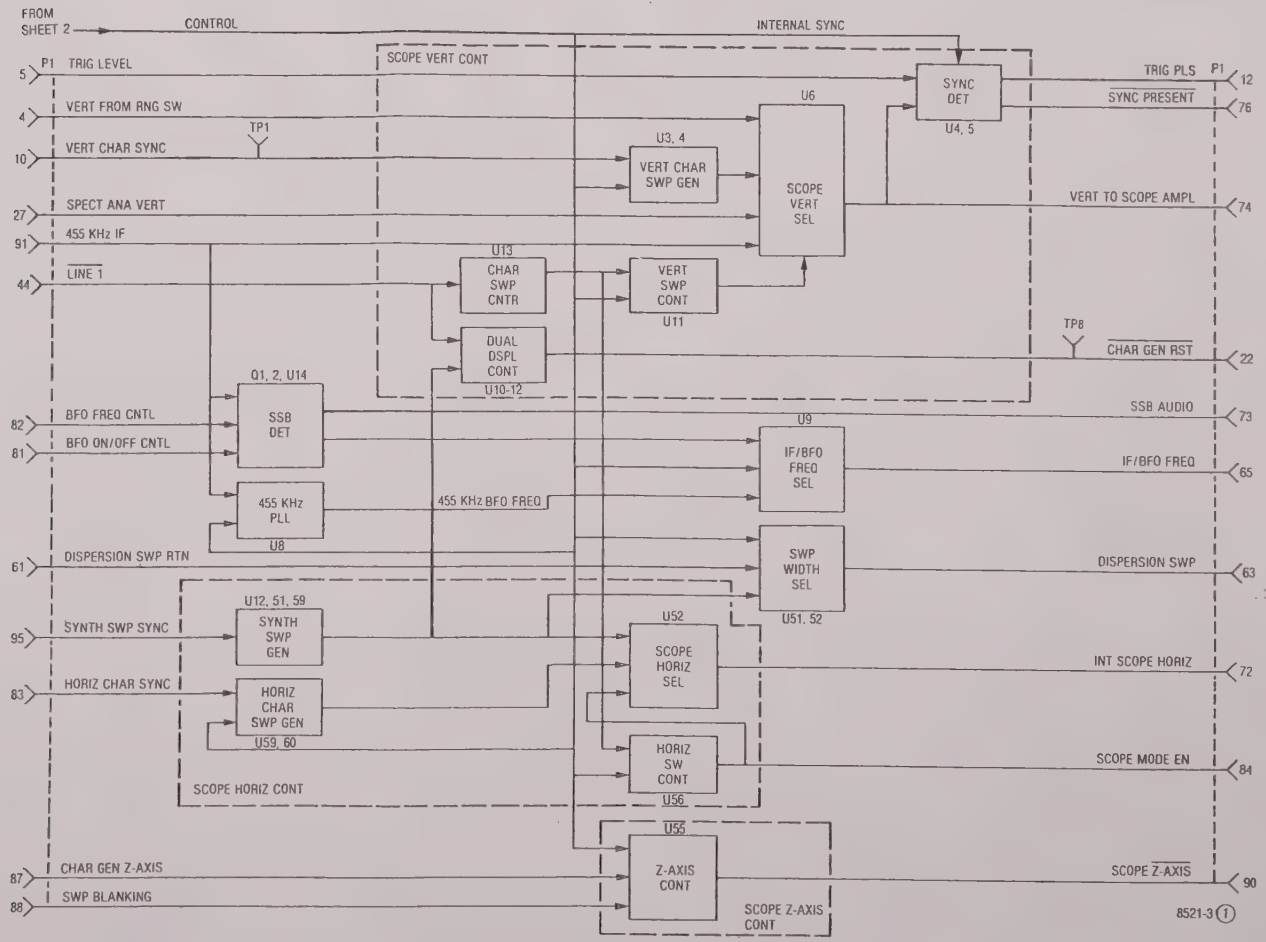



Figure 9-1. Scope/DVM Control Module A3 Block Diagram (Sheet 1 of 2)

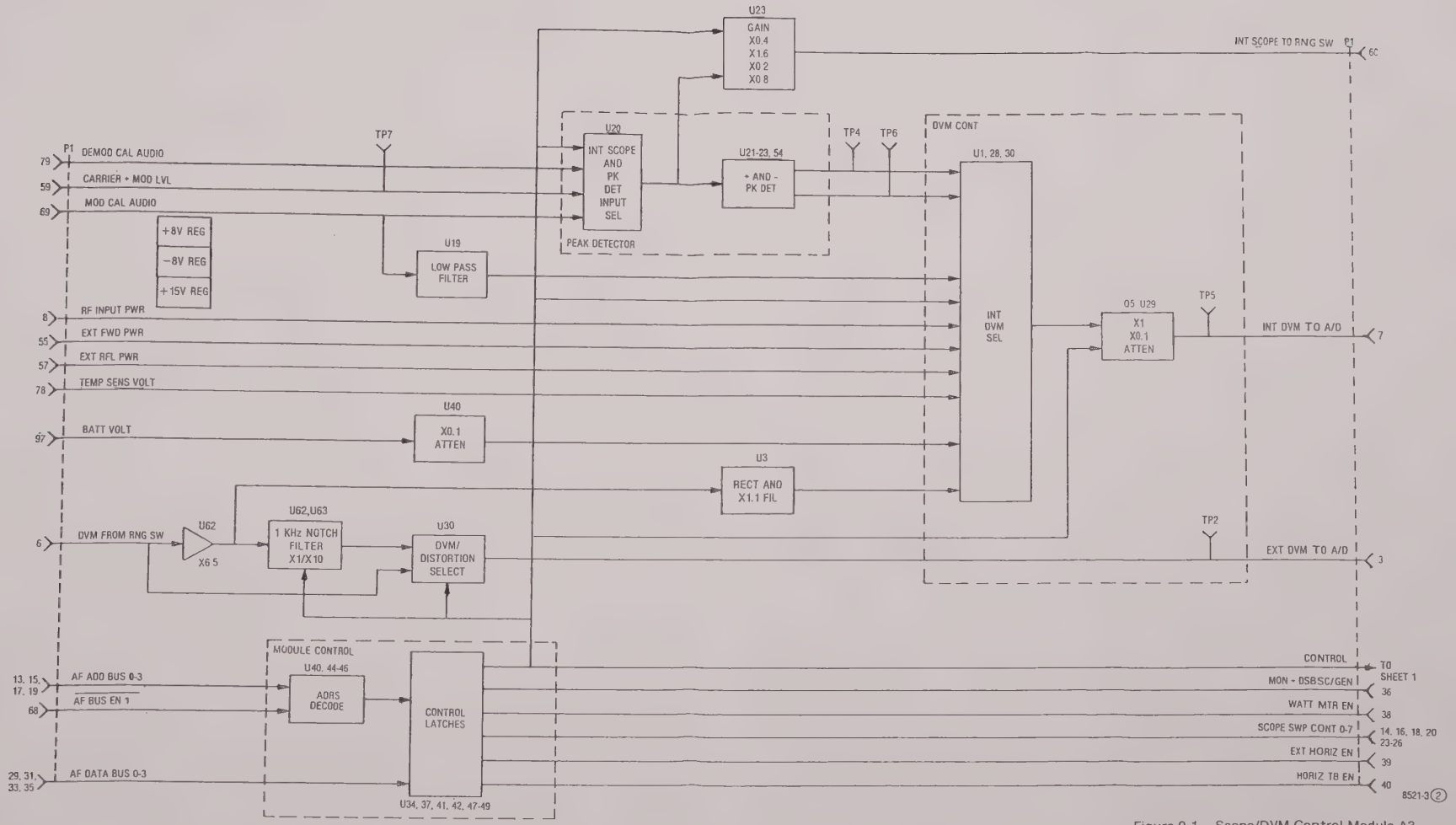



Figure 9-1. Scope/DVM Control Module A3 Block Diagram (Sheet 2 of 2)

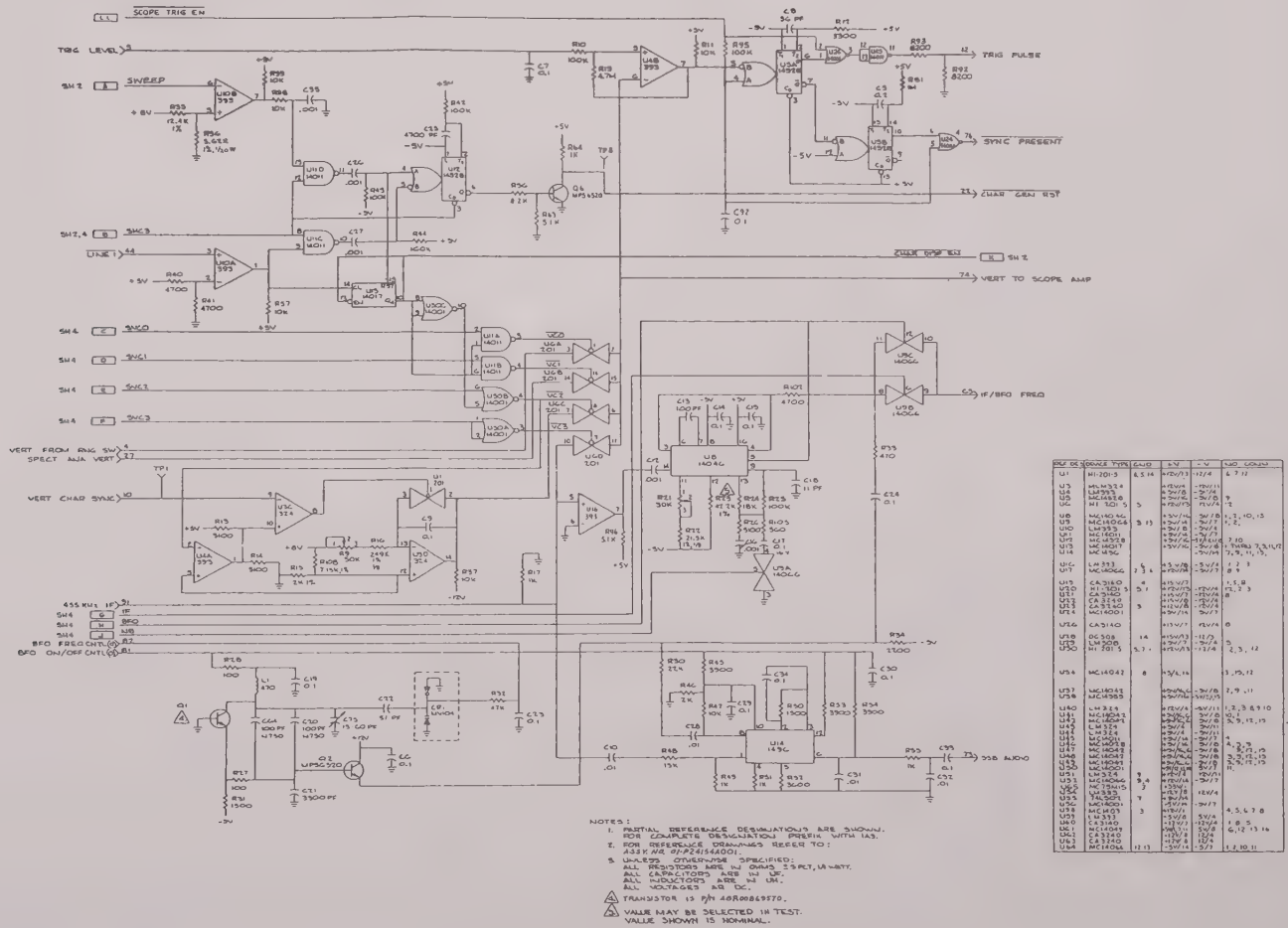
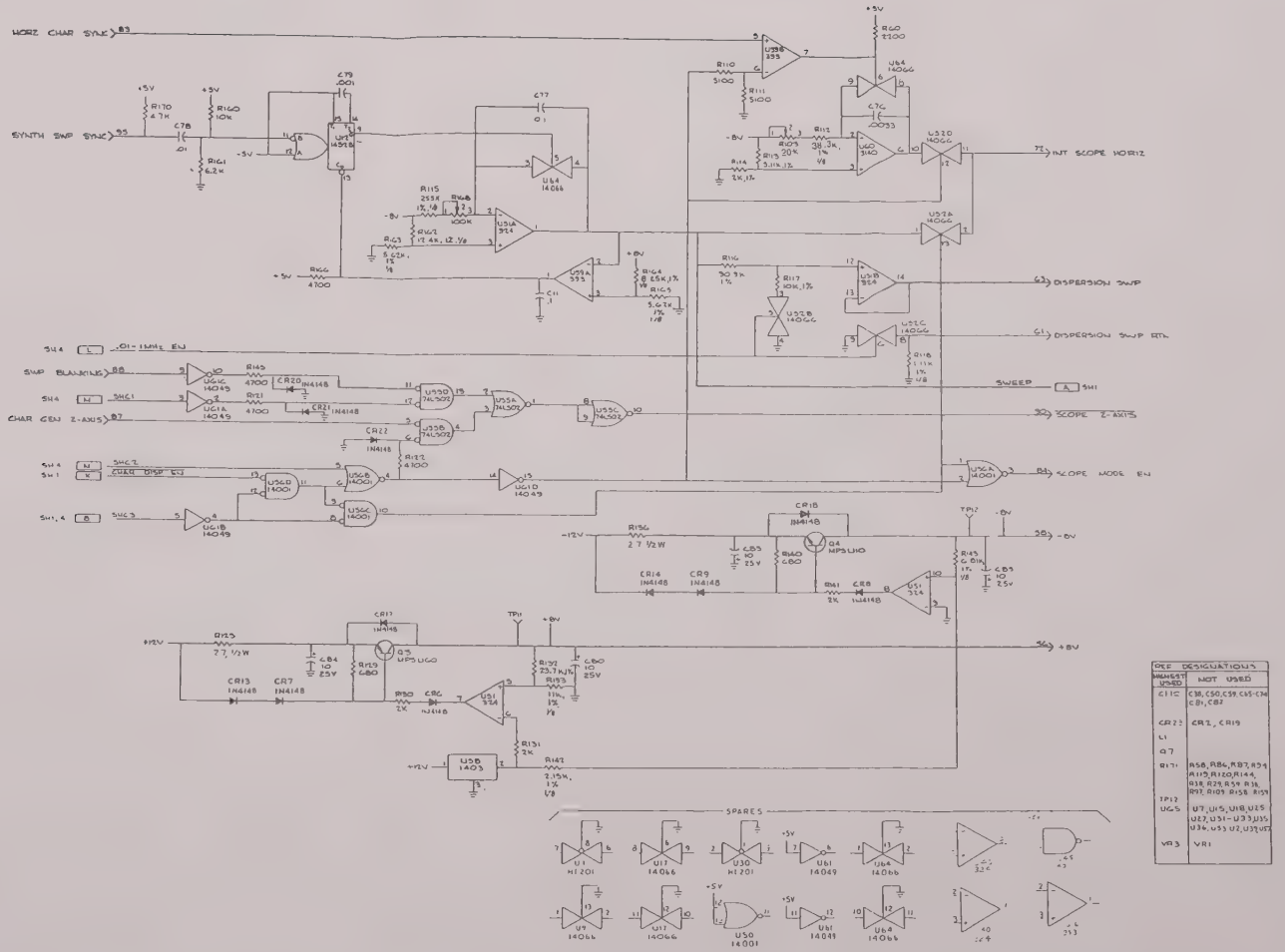

SCOPE TRIG EN
TRIG LEVEL
SWEEP
SYNC 0
SYNC 1
SYNC 2
SYNC 3
VERT FROM RNG SW
SPECT AMP VERT
VERT CHAN SYNC
455 KHz IF
IF
BFO
BFO FREQ CNTL
BFO ON/OFF CNTL
TRIG PULSE
SYNC PRESENT
CHAN GRN RST
CHAN GRN SET
SW 2
VERT TO SCOPE AMP
IF/BFO FREQ
SSB AUDIO
NOTES:
1. PARTIAL REFERENCE DESIGNATIONS ARE SHOWN. FOR COMPLETE DESIGNATION PREFIX WITH 1A3.
2. FOR REFERENCE DRAWINGS REFER TO: A33X NR 01-PZ4154A001.
3. UNLESS OTHERWISE SPECIFIED: ALL RESISTORS ARE IN OHMS ±5 PCT, 1/4 WATT. ALL CAPACITORS ARE IN UF. ALL INDUCTORS ARE IN UH. ALL VOLTAGES ARE DC.
4. TRANSISTOR IS P/N 48R00869570.
5. VALUE MAY BE SELECTED IN TEST. VALUE SHOWN IS NOMINAL.

Figure 9-2. Scope/DVM Control Module A3 Schematic Diagram (Sheet 1 of 4)




| REF DESIGNATIONS | |
|---|---|
| HIGHEST USED | NOT USED |
| C115 | C38, C50, C59, C65-C76, C81, C82 |
| CR23 | CR2, CR19 |
| L1 | |
| Q7 | |
| R171 | R58, R84, R87, R94, R115, R120, R144, R38, R29, R59, R36, R97, R105, R158, R159 |
| TP12 | |
| U65 | U7, U15, U18, U25, U27, U31-U33, U35, U36, U53, U2, U37, U52 |
| VR3 | VR1 |

Figure 9-2. Scope/DVM Control Module A3 Schematic Diagram (Sheet 2 of 4)

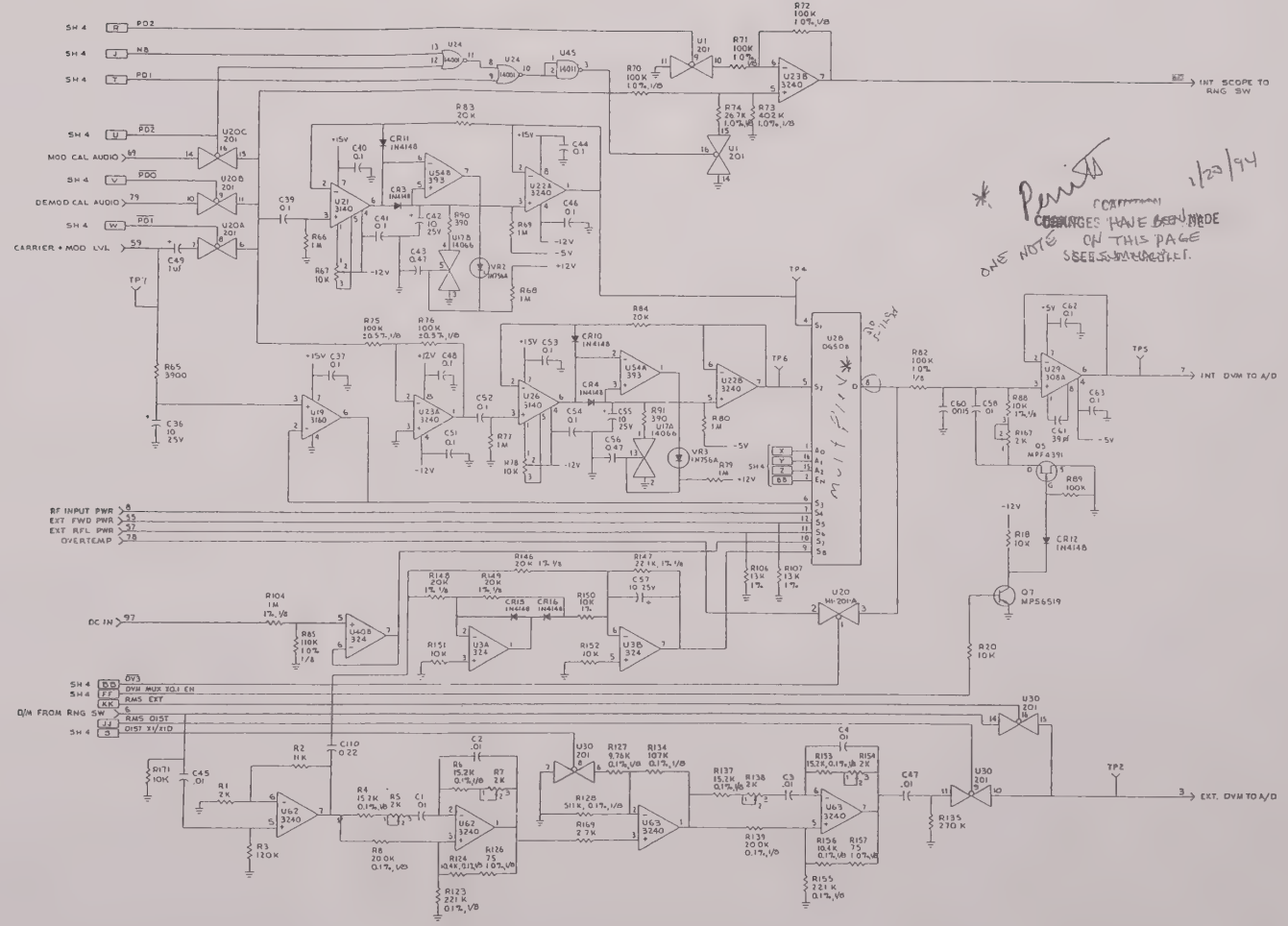



Figure 9-2. Scope/DVM Control Module A3 Schematic Diagram (Sheet 3 of 4)

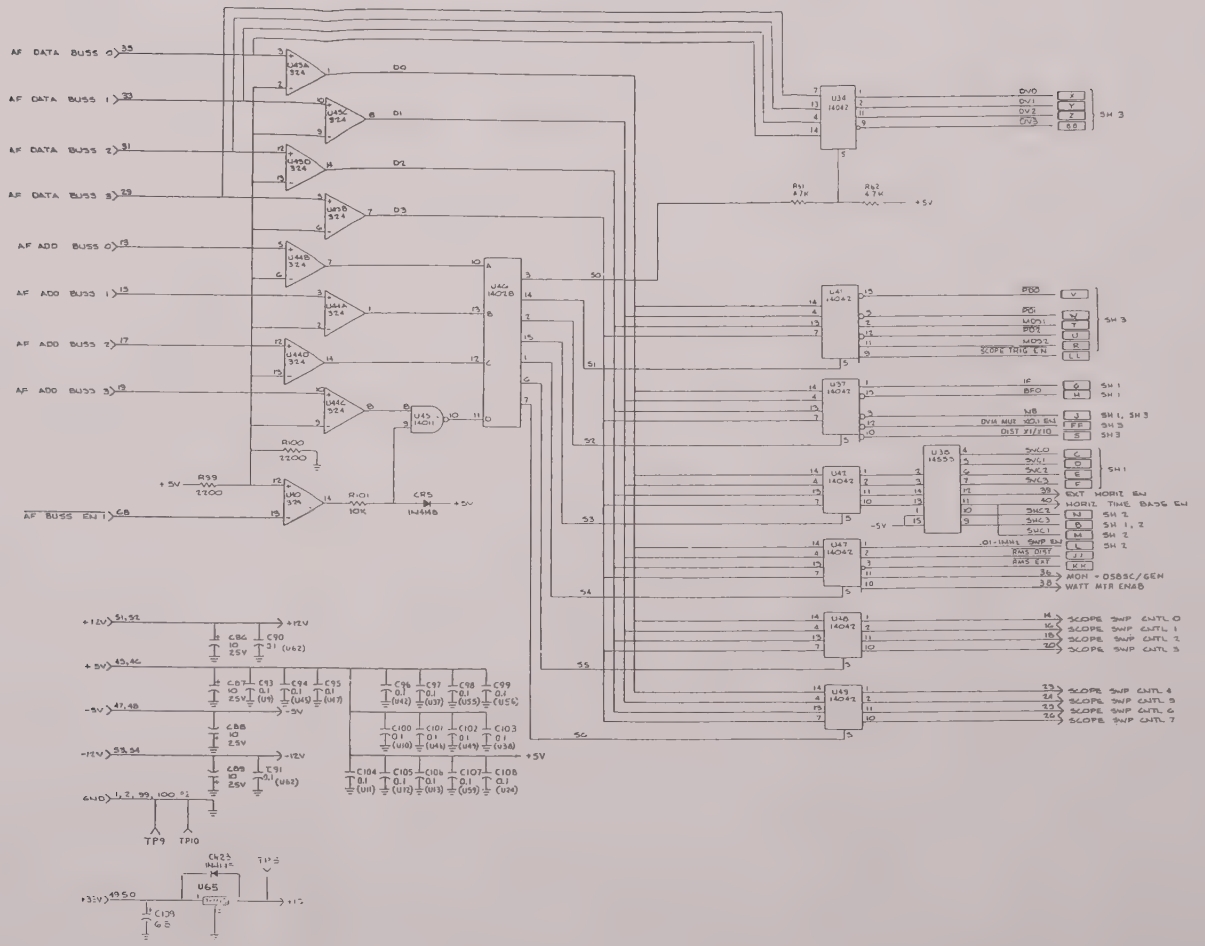



Figure 9-2. Scope/DVM Control Module A3
Schematic Diagram (Sheet 4 of 4)

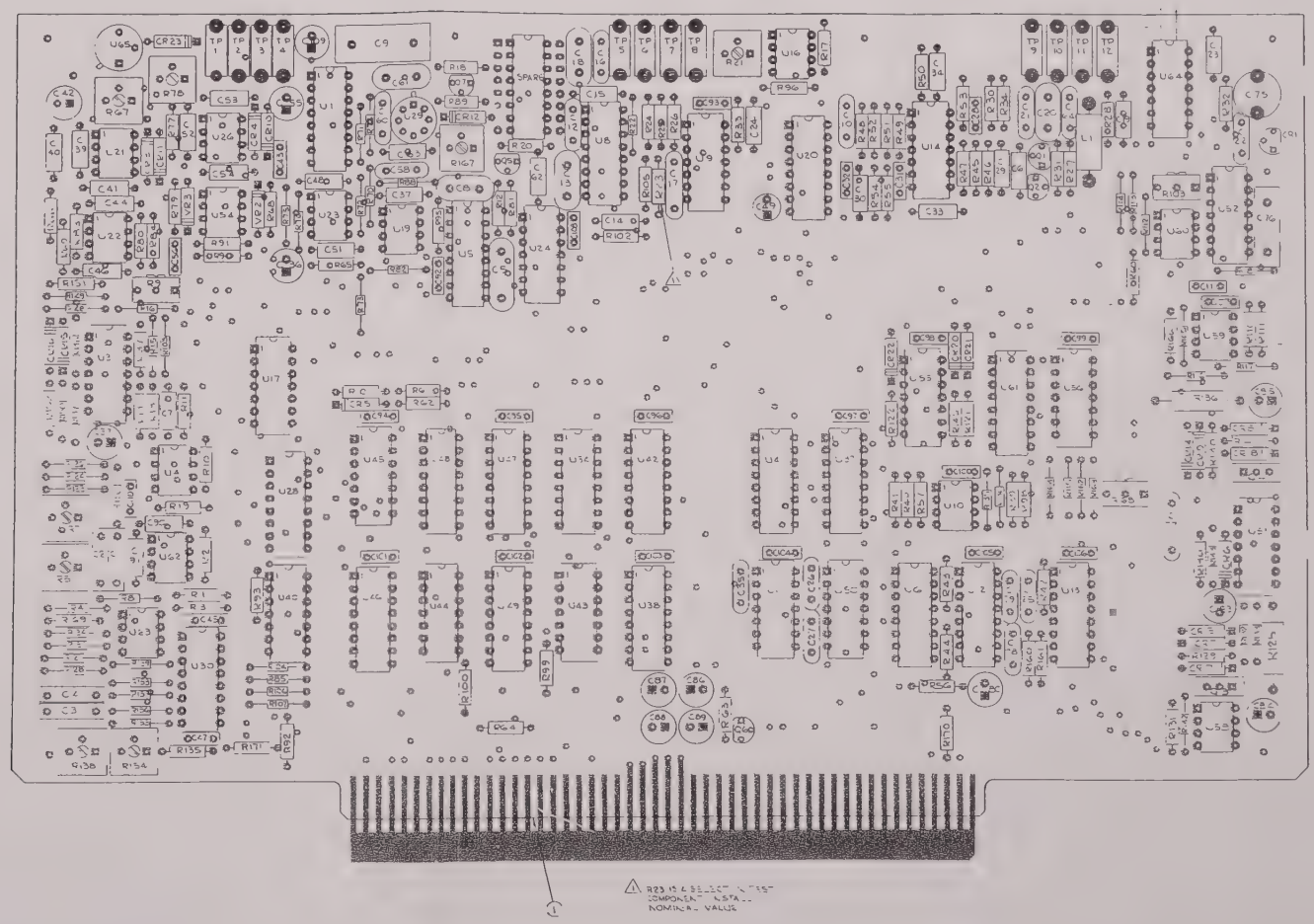


Figure 9-3. Scope/DVM Control Module
A3 (RTC-4024A) Parts Location
Diagram (Sheet 1 of 3)

| Find No. | Qty. Req. | Part No. | Nomenclature | Part Value |
|---|---|---|---|---|
| | | RTC-4024A | SCOPE/DVM CONTROL | |
| 001 | 1 | 84-P24171A001 | PWB,SCOPE/DVM CONT | |
| 002 | AR | SN63WRP3 | SOLDER | |
| 003 | AR | 11-14167A01 | INK | BLACK |
| 004 | 1 | 07-80335A63 | BRACKET,PWB MTG | |
| 005 | 4 | MS20470AD4-5 | RIVET | 1/8X.312 |
| 006 | 2 | 5C84500B03 | EYELET | |
| 007 | 2 | 42C84284B01 | RETAINER | |
| 008 | 2 | 03-139581 | SCREW,PH | 4-40X.312 |
| C 001 | 1 | 21-80396A53 | CAPACITOR | .01UF-5-100 |
| C 002 | 1 | 21-80396A53 | CAPACITOR | .01UF-5-100 |
| C 003 | 1 | 21-80396A53 | CAPACITOR | .01UF-5-100 |
| C 004 | 1 | 21-80396A53 | CAPACITOR | .01UF-5-100 |
| C 005 | 1 | 21C82372C05 | CAPACITOR | .2UF+80-20-25 |
| C 006 | 1 | 21-80396A49 | CAPACITOR | .1UF-20-100 |
| C 007 | 1 | 21-80396A49 | CAPACITOR | .1UF-20-100 |
| C 008 | 1 | 21D84494B45 | CAPACITOR | 56PF-5-500 |
| C 009 | 1 | 08D82905G27 | CAPACITOR | 0.1UF-10-50 |
| C 010 | 1 | 21-80396A52 | CAPACITOR | .01UF-20+80-200 |
| C 011 | 1 | 21-80370A05 | CAPACITOR | .1UF-10-100 |
| C 012 | 1 | 21-80396A51 | CAPACITOR | 1000PF-10-100 |
| C 013 | 1 | 21D84494B04 | CAPACITOR | 100PF-5-500 |
| C 014 | 1 | 21-80396A49 | CAPACITOR | .1UF-20-100 |
| C 015 | 1 | 21-80396A49 | CAPACITOR | .1UF-20-100 |
| C 016 | 1 | 21-80396A51 | CAPACITOR | 1000PF-10-100 |
| C 017 | 1 | 21-80348A89 | CAPACITOR | .1UF-20-16 |
| C 018 | 1 | 21D84494B37 | CAPACITOR | 11PF-5-500 |
| C 019 | 1 | 21-80396A49 | CAPACITOR | .1UF-20-100 |
| C 020 | 1 | 21D82610C58 | CAPACITOR | 100PF-N750 |
| C 021 | 1 | 21D82428B10 | CAPACITOR | 3300PF-10-100 |
| C 022 | 1 | 21D84494B01 | CAPACITOR | 51PF-5-500 |
| C 023 | 1 | 21-80396A49 | CAPACITOR | .1UF-20-100 |
| C 024 | 1 | 21-80396A49 | CAPACITOR | .1UF-20-100 |
| C 025 | 1 | 21D82428B09 | CAPACITOR | 4700PF-10-100 |
| C 026 | 1 | 21-80396A51 | CAPACITOR | 1000PF-10-100 |
| C 027 | 1 | 21-80396A51 | CAPACITOR | 1000PF-10-100 |
| C 028 | 1 | 21-80396A45 | CAPACITOR | .01UF-20-200 |
| C 029 | 1 | 21-80396A49 | CAPACITOR | .1UF-20-100 |
| C 030 | 1 | 21-80396A49 | CAPACITOR | .1UF-20-100 |
| C 031 | 1 | 21-80396A46 | CAPACITOR | .01UF-20-200 |
| C 032 | 1 | 21-80396A46 | CAPACITOR | .01UF-20-200 |
| C 033 | 1 | 21-80396A49 | CAPACITOR | .1UF-20-100 |
| C 034 | 1 | 21-80396A49 | CAPACITOR | .1UF-20-100 |
| C 035 | 1 | 21-80396A51 | CAPACITOR | 1000PF-10-100 |
| C 036 | 1 | 23-80396A40 | CAPACITOR | 10UF-25V |
| C 037 | 1 | 21-80396A49 | CAPACITOR | .1UF-20-100 |
| C 039 | 1 | 21-80396A49 | CAPACITOR | .1UF-20-100 |
| C 040 | 1 | 21-80396A49 | CAPACITOR | .1UF-20-100 |
| C 041 | 1 | 21-80396A49 | CAPACITOR | .1UF-20-100 |
| C 042 | 1 | 23-80396A40 | CAPACITOR | 10UF-25V |
| C 043 | 1 | 23-80369A60 | CAPACITOR | .47UF-10-50 |
| C 044 | 1 | 21-80396A49 | CAPACITOR | .1UF-20-100 |
| C 045 | 1 | 21-80396A46 | CAPACITOR | .01UF-20-200 |
| C 046 | 1 | 21-80396A49 | CAPACITOR | .1UF-20-100 |
| C 047 | 1 | 21-80396A46 | CAPACITOR | .01UF-20-200 |
| C 048 | 1 | 21-80396A49 | CAPACITOR | .1UF-20-100 |
| C 049 | 1 | 23D83441B15 | CAPACITOR | 1.0UF-20-35 |
| C 051 | 1 | 21-80396A49 | CAPACITOR | .1UF-20-100 |
| C 052 | 1 | 21-80396A49 | CAPACITOR | .1UF-20-100 |
| C 053 | 1 | 21-80396A49 | CAPACITOR | .1UF-20-100 |
| C 054 | 1 | 21-80396A49 | CAPACITOR | .1UF-20-100 |
| C 055 | 1 | 23-80396A40 | CAPACITOR | 10UF-25V |
| C 056 | 1 | 23-80369A60 | CAPACITOR | .47UF-10-50 |
| C 057 | 1 | 23-80396A40 | CAPACITOR | 10UF-25V |
| C 058 | 1 | 21D82428B62 | CAPACITOR | .01UF-20+80-200 |
| C 060 | 1 | 21D82187B11 | CAPACITOR | 1500PF-10-100 |

| Find No. | Qty. Req. | Part No. | Nomenclature | Part Value |
|---|---|---|---|---|
| C 061 | 1 | 21D84494B24 | CAPACITOR | 39PF-5-500 |
| C 062 | 1 | 21-80396A49 | CAPACITOR | .1UF-20-100 |
| C 063 | 1 | 21-80396A49 | CAPACITOR | .1UF-20-100 |
| C 064 | 1 | 21D82610C58 | CAPACITOR | 100PF-N750 |
| C 075 | 1 | 19-80370A36 | CAPACITOR | 15 TO 60PF-200 |
| C 076 | 1 | 08D82905G25 | CAPACITOR | .0033-10-100 |
| C 077 | 1 | 21-80348A89 | CAPACITOR | .1UF-20-16 |
| C 078 | 1 | 21-80396A52 | CAPACITOR | .01UF-20+80-200 |
| C 079 | 1 | 21-80396A51 | CAPACITOR | 1000PF-10-100 |
| C 080 | 1 | 23-80396A40 | CAPACITOR | 10UF-25V |
| C 083 | 1 | 23-80396A40 | CAPACITOR | 10UF-25V |
| C 084 | 1 | 23-80396A40 | CAPACITOR | 10UF-25V |
| C 085 | 1 | 23-80396A40 | CAPACITOR | 10UF-25V |
| C 086 | 1 | 23-80396A40 | CAPACITOR | 10UF-25V |
| C 087 | 1 | 23-80396A40 | CAPACITOR | 10UF-25V |
| C 088 | 1 | 23-80396A40 | CAPACITOR | 10UF-25V |
| C 089 | 1 | 23-80396A40 | CAPACITOR | 10UF-25V |
| C 090 | 1 | 21-80396A49 | CAPACITOR | .1UF-20-100 |
| C 091 | 1 | 21-80396A49 | CAPACITOR | .1UF-20-100 |
| C 092 | 1 | 21-80369A82 | CAPACITOR | .1UF-20-100 |
| C 093 | 1 | 21-80369A82 | CAPACITOR | .1UF-20-100 |
| C 094 | 1 | 21-80369A82 | CAPACITOR | .1UF-20-100 |
| C 095 | 1 | 21-80369A82 | CAPACITOR | .1UF-20-100 |
| C 096 | 1 | 21-80369A82 | CAPACITOR | .1UF-20-100 |
| C 097 | 1 | 21-80369A82 | CAPACITOR | .1UF-20-100 |
| C 098 | 1 | 21-80369A82 | CAPACITOR | .1UF-20-100 |
| C 099 | 1 | 21-80369A82 | CAPACITOR | .1UF-20-100 |
| C 100 | 1 | 21-80369A82 | CAPACITOR | .1UF-20-100 |
| C 101 | 1 | 21-80369A82 | CAPACITOR | .1UF-20-100 |
| C 102 | 1 | 21-80369A82 | CAPACITOR | .1UF-20-100 |
| C 103 | 1 | 21-80369A82 | CAPACITOR | .1UF-20-100 |
| C 104 | 1 | 21-80369A82 | CAPACITOR | .1UF-20-100 |
| C 105 | 1 | 21-80369A82 | CAPACITOR | .1UF-20-100 |
| C 106 | 1 | 21-80369A82 | CAPACITOR | .1UF-20-100 |
| C 107 | 1 | 21-80369A82 | CAPACITOR | .1UF-20-100 |
| C 108 | 1 | 21-80369A82 | CAPACITOR | .1UF-20-100 |
| C 109 | 1 | 23-80396A45 | CAPACITOR | 6.8UF-20+50-50 |
| C 110 | 1 | 23-80396A33 | CAPACITOR | .22UF-20-50 |
| CR001 | 1 | 48-80345A73 | DIODE | |
| CR003 | 1 | 48-84463K02 | DIODE | |
| CR004 | 1 | 48-84463K02 | DIODE | |
| CR005 | 1 | 48-84463K02 | DIODE | |
| CR006 | 1 | 48-84463K02 | DIODE | |
| CR007 | 1 | 48-84463K02 | DIODE | |
| CR008 | 1 | 48-84463K02 | DIODE | |
| CR009 | 1 | 48-84463K02 | DIODE | |
| CR010 | 1 | 48-84463K02 | DIODE | |
| CR011 | 1 | 48-84463K02 | DIODE | |
| CR012 | 1 | 48-84463K02 | DIODE | |
| CR013 | 1 | 48-84463K02 | DIODE | |
| CR014 | 1 | 48-84463K02 | DIODE | |
| CR015 | 1 | 48-84463K02 | DIODE | |
| CR016 | 1 | 48-84463K02 | DIODE | |
| CR017 | 1 | 48-84463K02 | DIODE | |
| CR018 | 1 | 48-84463K02 | DIODE | |
| CR020 | 1 | 48-84463K02 | DIODE | |
| CR021 | 1 | 48-84463K02 | DIODE | |
| CR022 | 1 | 48-84463K02 | DIODE | |
| CR023 | 1 | 48-84463K02 | DIODE | |
| L 001 | 1 | 24-80348A83 | COIL | 470UH |
| Q 001 | 1 | 48R00869570 | TRANSISTOR | |
| Q 002 | 1 | 48-80368A91 | TRANSISTOR | MPS6520 SCREENED |
| Q 003 | 1 | 48-80341A48 | TRANSISTOR | MPS-U60 SCREENED |
| Q 004 | 1 | 48-80341A47 | TRANSISTOR | MPS-U10 SCREENED |
| Q 005 | 1 | 48-80345A48 | TRANSISTOR | |

| Find No. | Qty. Req. | Part No. | Nomenclature | Part Value |
|---|---|---|---|---|
| Q 006 | 1 | 48-80368A91 | TRANSISTOR | MPS6520 SCREENED |
| Q 007 | 1 | 48-80368A92 | TRANSISTOR | MPS6519 SCREENED |
| R 001 | 1 | 6S124A56 | RESISTOR | 2.0K-5-1/4 |
| R 002 | 1 | 6S124A74 | RESISTOR | 11K-5-1/4 |
| R 003 | 1 | 6S124A99 | RESISTOR | 120K-5-1/4 |
| R 004 | 1 | 06-80396A63 | RESISTOR | 15.2K-.1-1/8 |
| R 005 | 1 | 18D83452F02 | RESISTOR,VARIABLE | 2K |
| R 006 | 1 | 06-80396A63 | RESISTOR | 15.2K-.1-1/8 |
| R 007 | 1 | 18D83452F02 | RESISTOR,VARIABLE | 2K |
| R 008 | 1 | 06-80396A64 | RESISTOR | 20K-.1-1/8 |
| R 009 | 1 | 18D83452F17 | RESISTOR,VARIABLE | 50K |
| R 010 | 1 | 6S124A97 | RESISTOR | 100K-5-1/4 |
| R 011 | 1 | 6S124A73 | RESISTOR | 10K-5-1/4 |
| R 012 | 1 | 6S124A61 | RESISTOR | 3.3K-5-1/4 |
| R 013 | 1 | 6S124A66 | RESISTOR | 5.1K-5-1/4 |
| R 014 | 1 | 6S124A66 | RESISTOR | 5.1K-5-1/4 |
| R 015 | 1 | 06D84444A16 | RESISTOR | 2000-1-1/4 |
| R 016 | 1 | 06-10621E27 | RESISTOR | 249K-1-1/8 |
| R 017 | 1 | 6S124A49 | RESISTOR | 1K-5-1/4 |
| R 018 | 1 | 6S124A73 | RESISTOR | 10K-5-1/4 |
| R 019 | 1 | 6S124B38 | RESISTOR | 4.7M-5-1/4 |
| R 020 | 1 | 6S124A73 | RESISTOR | 10K-5-1/4 |
| R 021 | 1 | 18D83452F18 | RESISTOR,VARIABLE | 50K |
| R 022 | 1 | 06-10621D24 | RESISTOR | 21.5K-1-1/8 |
| R 023 | 1 | 06D84444A27 | RESISTOR | 42.2K-1-1/4 NOMIN |
| R 023 | S01 | 6S124A83 | RESISTOR | 27K-5-1/4 |
| R 023 | S01 | 6S124A85 | RESISTOR | 33K-5-1/4 |
| R 023 | S01 | 6S124A87 | RESISTOR | 39K-5-1/4 |
| R 023 | S01 | 6S124A89 | RESISTOR | 47K-5-1/4 |
| R 023 | S01 | 6S124A91 | RESISTOR | 56K-5-1/4 |
| R 023 | S01 | 6S124A93 | RESISTOR | 68K-5-1/4 |
| R 024 | 1 | 6S124A79 | RESISTOR | 18K-5-1/4 |
| R 025 | 1 | 6S124A97 | RESISTOR | 100K-5-1/4 |
| R 026 | 1 | 6S124A66 | RESISTOR | 5.1K-5-1/4 |
| R 027 | 1 | 6S124A25 | RESISTOR | 100-5-1/4 |
| R 028 | 1 | 6S124A25 | RESISTOR | 100-5-1/4 |
| R 030 | 1 | 6S124A81 | RESISTOR | 22K-5-1/4 |
| R 031 | 1 | 6S124A53 | RESISTOR | 1.5K-5-1/4 |
| R 032 | 1 | 6S124A89 | RESISTOR | 47K-5-1/4 |
| R 033 | 1 | 6S124A41 | RESISTOR | 470-5-1/4 |
| R 034 | 1 | 6S124A57 | RESISTOR | 2.2K-5-1/4 |
| R 035 | 1 | 06-10621D01 | RESISTOR | 12.4K-1-1/8 |
| R 036 | 1 | 06D84444A45 | RESISTOR | 5.62K-1-1/20 |
| R 037 | 1 | 6S124A73 | RESISTOR | 10K-5-1/4 |
| R 039 | 1 | 6S124A73 | RESISTOR | 10K-5-1/4 |
| R 040 | 1 | 6S124A65 | RESISTOR | 4.7K-5-1/4 |
| R 041 | 1 | 6S124A65 | RESISTOR | 4.7K-5-1/4 |
| R 042 | 1 | 6S124A97 | RESISTOR | 100K-5-1/4 |
| R 043 | 1 | 6S124A97 | RESISTOR | 100K-5-1/4 |
| R 044 | 1 | 6S124A97 | RESISTOR | 100K-5-1/4 |
| R 045 | 1 | 6S124A63 | RESISTOR | 3.9K-5-1/4 |
| R 046 | 1 | 6S124A56 | RESISTOR | 2.0K-5-1/4 |
| R 047 | 1 | 6S124A73 | RESISTOR | 10K-5-1/4 |
| R 048 | 1 | 6S124A77 | RESISTOR | 15K-5-1/4 |
| R 049 | 1 | 6S124A49 | RESISTOR | 1K-5-1/4 |
| R 050 | 1 | 6S124A53 | RESISTOR | 1.5K-5-1/4 |
| R 051 | 1 | 6S124A49 | RESISTOR | 1K-5-1/4 |

Figure 9-3. Scope/DVM Control Module A3 (RTC-4024A) Parts Location Diagram (Sheet 2 of 3)

| Find No. | Qty. Req. | Part No. | Nomenclature | Part Value |
|---|---|---|---|---|
| R 052 | 1 | 6S124A62 | RESISTOR | 3.6K-5-1/4 |
| R 053 | 1 | 6S124A63 | RESISTOR | 3.9K-5-1/4 |
| R 054 | 1 | 6S124A63 | RESISTOR | 3.9K-5-1/4 |
| R 055 | 1 | 6S124A49 | RESISTOR | 1K-5-1/4 |
| R 056 | 1 | 6S124A71 | RESISTOR | 8.2K-5-1/4 |
| R 057 | 1 | 6S124A73 | RESISTOR | 10K-5-1/4 |
| R 060 | 1 | 6S124A57 | RESISTOR | 2.2K-5-1/4 |
| R 061 | 1 | 6S124A65 | RESISTOR | 4.7K-5-1/4 |
| R 062 | 1 | 6S124A65 | RESISTOR | 4.7K-5-1/4 |
| R 063 | 1 | 6S124A66 | RESISTOR | 5.1K-5-1/4 |
| R 064 | 1 | 6S124A49 | RESISTOR | 1K-5-1/4 |
| R 065 | 1 | 6S124A63 | RESISTOR | 3.9K-5-1/4 |
| R 066 | 1 | 6S124B22 | RESISTOR | 1M-5-1/4 |
| R 067 | 1 | 18D83452F14 | RESISTOR,VARIABLE | 10K |
| R 068 | 1 | 6S124B22 | RESISTOR | 1M-5-1/4 |
| R 069 | 1 | 6S124B22 | RESISTOR | 1M-5-1/4 |
| R 070 | 1 | 06-10621D88 | RESISTOR | 100K-1-1/8 |
| R 071 | 1 | 06-10621D88 | RESISTOR | 100K-1-1/8 |
| R 072 | 1 | 06-10621D88 | RESISTOR | 100K-1-1/8 |
| R 073 | 1 | 06-10621E47 | RESISTOR | 402K-1-1/8 |
| R 074 | 1 | 06-10621A42 | RESISTOR | 26.7K-1-1/8 |
| R 075 | 1 | 06-80396A58 | RESISTOR | 100K-.5-1/8 |
| R 076 | 1 | 06-80396A58 | RESISTOR | 100K-.5-1/8 |
| R 077 | 1 | 6S124B22 | RESISTOR | 1M-5-1/4 |
| R 078 | 1 | 18D83452F14 | RESISTOR,VARIABLE | 10K |
| R 079 | 1 | 6S124B22 | RESISTOR | 1M-5-1/4 |
| R 080 | 1 | 6S124B22 | RESISTOR | 1M-5-1/4 |
| R 081 | 1 | 6S124B22 | RESISTOR | 1M-5-1/4 |
| R 082 | 1 | 06-10621D88 | RESISTOR | 100K-1-1/8 |
| R 083 | 1 | 6S124A80 | RESISTOR | 20K-5-1/4 |
| R 084 | 1 | 6S124A80 | RESISTOR | 20K-5-1/4 |
| R 085 | 1 | 06-10621D92 | RESISTOR | 110K-1-1/8 |
| R 088 | 1 | 06-10621C91 | RESISTOR | 10K-1-1/8 |
| R 089 | 1 | 6S124A97 | RESISTOR | 100K-5-1/4 |
| R 090 | 1 | 6S124A39 | RESISTOR | 390-5-1/4 |
| R 091 | 1 | 6S124A39 | RESISTOR | 390-5-1/4 |
| R 092 | 1 | 6S124A71 | RESISTOR | 8200-5-1/4 |
| R 093 | 1 | 6S124A71 | RESISTOR | 8200-5-1/4 |
| R 095 | 1 | 6S124A97 | RESISTOR | 100K-5-1/4 |
| R 096 | 1 | 6S124A66 | RESISTOR | 5.1K-5-1/4 |
| R 098 | 1 | 6S124A73 | RESISTOR | 10K-5-1/4 |
| R 099 | 1 | 6S124A57 | RESISTOR | 2.2K-5-1/4 |
| R 100 | 1 | 6S124A57 | RESISTOR | 2.2K-5-1/4 |
| R 101 | 1 | 6S124A73 | RESISTOR | 10K-5-1/4 |
| R 102 | 1 | 6S124A65 | RESISTOR | 4.7K-5-1/4 |
| R 103 | 1 | 18D83452F15 | RESISTOR,VARIABLE | 20K |
| R 104 | 1 | 06-10621E85 | RESISTOR | 1M-1-1/8 |
| R 105 | 1 | 6S124A43 | RESISTOR | 560-5-1/4 |
| R 106 | 1 | 06D83175C12 | RESISTOR | 13.0K-1-1/4 |
| R 107 | 1 | 06D83175C12 | RESISTOR | 13.0K-1-1/4 |
| R 108 | 1 | 06D84444A42 | RESISTOR | 7.15K-1-1/4 |
| R 110 | 1 | 6S124A66 | RESISTOR | 5.1K-5-1/4 |
| R 111 | 1 | 6S124A66 | RESISTOR | 5.1K-5-1/4 |
| R 112 | 1 | 06-10621D48 | RESISTOR | 38.3K-1-1/8 |
| R 113 | 1 | 06D83175C83 | RESISTOR | 5.11K-1-1/4 |
| R 114 | 1 | 06D84444A16 | RESISTOR | 2000-1-1/4 |
| R 115 | 1 | 06-10621E28 | RESISTOR | 255K-1-1/8 |
| R 116 | 1 | 06D83175C76 | RESISTOR | 90.9K-1-1/4 |
| R 117 | 1 | 06D83175C03 | RESISTOR | 10K-1-1/4 |
| R 118 | 1 | 06-10621B98 | RESISTOR | 1100-1-1/8 |
| R 121 | 1 | 6S124A65 | RESISTOR | 4.7K-5-1/4 |
| R 122 | 1 | 6S124A65 | RESISTOR | 4.7K-5-1/4 |
| R 123 | 1 | 06-80396A65 | RESISTOR | 221K-.1-1/8 |
| R 124 | 1 | 06-80396A61 | RESISTOR | 10.4K-.1-1/8 |
| R 125 | 1 | 6S125B55 | RESISTOR | 2.7-5-1/2 |
| R 126 | 1 | 06-10621A85 | RESISTOR | 75-1-1/8 |
| R 127 | 1 | 06-80396A72 | RESISTOR | 9760-.1-1/8 |
| R 128 | 1 | 06-80396A58 | RESISTOR | 511K-.1-1/8 |
| R 129 | 1 | 6S124A45 | RESISTOR | 680-5-1/4 |
| R 130 | 1 | 6S124A56 | RESISTOR | 2.0K-5-1/4 |
| R 131 | 1 | 6S124A56 | RESISTOR | 2.0K-5-1/4 |
| R 132 | 1 | 06-10621D28 | RESISTOR | 23.7K-1-1/8 |
| R 133 | 1 | 06-10621C95 | RESISTOR | 11K-1-1/8 |
| R 134 | 1 | 06-80396A82 | RESISTOR | 107K-.1-1/8 |
| R 135 | 1 | 6S124B08 | RESISTOR | 270K-5-1/4 |
| R 136 | 1 | 6S125B55 | RESISTOR | 2.7-5-1/2 |
| R 137 | 1 | 06-80396A53 | RESISTOR | 15.2K-.1-1/8 |
| R 138 | 1 | 18D83452F02 | RESISTOR,VARIABLE | 2K |
| R 139 | 1 | 06-80396A64 | RESISTOR | 20K-.1-1/8 |
| R 140 | 1 | 6S124A45 | RESISTOR | 680-5-1/4 |
| R 141 | 1 | 6S124A56 | RESISTOR | 2.0K-5-1/4 |
| R 142 | 1 | 06-10621C27 | RESISTOR | 2150-1-1/8 |
| R 143 | 1 | 06-82526F55 | RESISTOR | 8810-1-1/8 |
| R 145 | 1 | 6S124A65 | RESISTOR | 4.7K-5-1/4 |
| R 146 | 1 | 06-10621D21 | RESISTOR | 20K-1-1/8 |
| R 147 | 1 | 06-10621Q25 | RESISTOR | 22.1K-1-1/8 |
| R 148 | 1 | 06-10621D21 | RESISTOR | 20K-1-1/8 |
| R 149 | 1 | 06-10621D21 | RESISTOR | 20K-1-1/8 |
| R 150 | 1 | 06D83175C03 | RESISTOR | 10K-1-1/4 |
| R 151 | 1 | 6S124A73 | RESISTOR | 10K-5-1/4 |
| R 152 | 1 | 6S124A73 | RESISTOR | 10K-5-1/4 |
| R 153 | 1 | 06-80396A63 | RESISTOR | 15.2K-.1-1/8 |
| R 154 | 1 | 18D83452F02 | RESISTOR,VARIABLE | 2K |
| R 155 | 1 | 06-80396A55 | RESISTOR | 221K-.1-1/8 |
| R 156 | 1 | 06-80396A61 | RESISTOR | 10.4K-.1-1/8 |
| R 157 | 1 | 06-10621A85 | RESISTOR | 75-1-1/8 |
| R 160 | 1 | 6S124A73 | RESISTOR | 10K-5-1/4 |
| R 161 | 1 | 6S124A68 | RESISTOR | 6.2K-5-1/4 |
| R 162 | 1 | 06-10621D01 | RESISTOR | 12.4K-1-1/8 |
| R 163 | 1 | 06-10621C67 | RESISTOR | 5620-1-1/8 |
| R 164 | 1 | 06-10621C83 | RESISTOR | 8250-1-1/8 |
| R 165 | 1 | 06-10621C67 | RESISTOR | 5620-1-1/8 |
| R 166 | 1 | 6S124A65 | RESISTOR | 4.7K-5-1/4 |
| R 167 | 1 | 18D83452F02 | RESISTOR,VARIABLE | 2K |
| R 168 | 1 | 18D83452F19 | RESISTOR,VARIABLE | 100K |
| R 169 | 1 | 6S124A59 | RESISTOR | 2.7K-5-1/4 |
| R 170 | 1 | 6S124A65 | RESISTOR | 4.7K-5-1/4 |
| R 171 | 1 | 6S124A73 | RESISTOR | 10K-5-1/4 |
| TP001 | 1 | 09-80331A88 | JACK,TIP | WHT |
| TP002 | 1 | 09-80331A88 | JACK,TIP | WHT |
| TP003 | 1 | 09-80331A88 | JACK,TIP | WHT |
| TP004 | 1 | 09-80331A88 | JACK,TIP | WHT |
| TP005 | 1 | 09-80331A88 | JACK,TIP | WHT |
| TP006 | 1 | 09-80331A88 | JACK,TIP | WHT |
| TP007 | 1 | 09-80331A88 | JACK,TIP | WHT |
| TP008 | 1 | 09-80331A88 | JACK,TIP | WHT |
| TP009 | 1 | 09-80331A88 | JACK,TIP | WHT |
| TP010 | 1 | 09-80331A88 | JACK,TIP | WHT |
| TP011 | 1 | 09-80331A88 | JACK,TIP | WHT |
| TP012 | 1 | 09-80331A88 | JACK,TIP | WHT |
| U 001 | 1 | 51-80345A05 | INTEGRATED CIRCUIT | HI-201-5 SCREENED |
| U 003 | 1 | 51-80396A16 | INTEGRATED CIRCUIT | LM324N SCREENED |
| U 004 | 1 | 51-80345A10 | INTEGRATED CIRCUIT | LM393N SCREENED |
| U 005 | 1 | 51-80368A57 | INTEGRATED CIRCUIT | MC14528B SCREENED |
| U 006 | 1 | 51-80345A05 | INTEGRATED CIRCUIT | HI-201-5 SCREENED |
| U 008 | 1 | 51-80345A19 | INTEGRATED CIRCUIT | MC14066BCP SCREENE |
| U 009 | 1 | 51-82884L48 | INTEGRATED CIRCUIT | MC14066BCP SCREENE |
| U 010 | 1 | 51-80345A10 | INTEGRATED CIRCUIT | LM393N SCREENED |
| U 011 | 1 | 51080368A32 | INTEGRATED CIRCUIT | MC14011BCP SCREENE |
| U 012 | 1 | 51-80368A57 | INTEGRATED CIRCUIT | MC14528B SCREENED |
| U 013 | 1 | 51-80368A33 | INTEGRATED CIRCUIT | MC14017BCP SC |
| U 014 | 1 | 51-83222M05 | INTEGRATED CIRCUIT | MC1496P SCRE |
| U 016 | 1 | 51-80345A10 | INTEGRATED CIRCUIT | LM393N SCREENED |
| U 017 | 1 | 51-82884L48 | INTEGRATED CIRCUIT | MC14066BCP SCREENE |
| U 019 | 1 | 51-80345A02 | INTEGRATED CIRCUIT | CA3160E SCREENED |
| U 020 | 1 | 51-80345A05 | INTEGRATED CIRCUIT | HI-201-5 SCREENED |
| U 021 | 1 | 51-80345A01 | INTEGRATED CIRCUIT | CA3140E SCREENED |
| U 022 | 1 | 51-80345A04 | INTEGRATED CIRCUIT | CA3240E SCREENED |
| U 023 | 1 | 51-80345A04 | INTEGRATED CIRCUIT | CA3240E SCREENED |
| U 024 | 1 | 51-80368A56 | INTEGRATED CIRCUIT | MC14001BCP SCREENE |
| U 026 | 1 | 51-80345A01 | INTEGRATED CIRCUIT | CA3140E SCREENED |
| U 028 | 1 | 51-80396A13 | INTEGRATED CIRCUIT | DG508AP SCREENED |
| U 029 | 1 | 51-80368A83 | INTEGRATED CIRCUIT | LM308AH SCREENED |
| U 030 | 1 | 51-80345A05 | INTEGRATED CIRCUIT | HI-201-5 SCREENED |
| U 034 | 1 | 51-80368A58 | INTEGRATED CIRCUIT | MC14042B SCREENED |
| U 037 | 1 | 51-80368A58 | INTEGRATED CIRCUIT | MC14042B SCREENED |
| U 038 | 1 | 51-80368A52 | INTEGRATED CIRCUIT | MC14555BCP SCREENE |
| U 040 | 1 | 51-80396A16 | INTEGRATED CIRCUIT | LM324N SCREENED |
| U 041 | 1 | 51-80368A58 | INTEGRATED CIRCUIT | MC14042B SCREENED |
| U 042 | 1 | 51-80368A58 | INTEGRATED CIRCUIT | MC14042B SCREENED |
| U 043 | 1 | 51-80396A16 | INTEGRATED CIRCUIT | LM324N SCREENED |
| U 044 | 1 | 51-80396A16 | INTEGRATED CIRCUIT | LM324N SCREENED |
| U 045 | 1 | 51-80368A32 | INTEGRATED CIRCUIT | MC14011BCP SCREENE |
| U 046 | 1 | 51-80345A16 | INTEGRATED CIRCUIT | MC14028BCP SCREENE |
| U 047 | 1 | 51-80368A58 | INTEGRATED CIRCUIT | MC14042B SCREENED |
| U 048 | 1 | 51-80368A58 | INTEGRATED CIRCUIT | MC14042B SCREENED |
| U 049 | 1 | 51-80368A58 | INTEGRATED CIRCUIT | MC14042B SCREENED |
| U 050 | 1 | 51-80368A56 | INTEGRATED CIRCUIT | MC14001BCP SCREENE |
| U 051 | 1 | 51-80396A16 | INTEGRATED CIRCUIT | LM324N SCREENED |
| U 052 | 1 | 51-82884L48 | INTEGRATED CIRCUIT | MC14066BCP SCREENE |
| U 054 | 1 | 51-80345A10 | INTEGRATED CIRCUIT | LM393N SCREENED |
| U 055 | 1 | 51-80368A10 | INTEGRATED CIRCUIT | SN74LS02NS SC/ |
| U 056 | 1 | 51-80368A56 | INTEGRATED CIRCUIT | MC14001BCP SCR |
| U 058 | 1 | 51-80368A66 | INTEGRATED CIRCUIT | MC1403U SCREENED |
| U 059 | 1 | 51-80345A10 | INTEGRATED CIRCUIT | LM393N SCREENED |
| U 060 | 1 | 51-80345A01 | INTEGRATED CIRCUIT | CA3140E SCREENED |
| U 061 | 1 | 51-80368A36 | INTEGRATED CIRCUIT | MC14049BCP |
| U 062 | 1 | 51-80345A04 | INTEGRATED CIRCUIT | CA3240E SCREENED |
| U 063 | 1 | 51-80345A04 | INTEGRATED CIRCUIT | CA3240E SCREENED |
| U 064 | 1 | 51-82884L48 | INTEGRATED CIRCUIT | MC14066BCP SCREENE |
| U 065 | 1 | 51-80369A06 | INTEGRATED CIRCUIT | |
| VR002 | 1 | 48-80396A28 | DIODE,ZENER | 6.2V-5-.4 |
| VR003 | 1 | 48-80396A28 | DIODE,ZENER | 6.2V-5-.4 |

Figure 9-3.
Scope/DVM Control Module
A3 (RTC-4024A) Parts Location
Diagram (Sheet 3 of 3)

# SECTION 10
# RECEIVER (A4)

**10-1. General.** The Receiver down converts the 10.7 MHz first IF signal to 455 kHz. Following the down conversion a linear or a logarithimic IF amplifier provide the gain prior to AM and FM detectors or the spectrum analyzer detector respectively. Post detection filtering provides the wide or narrow band responses for the audio outputs. The audio amplifier for the speaker and the alarm generator are also contained on this module. A block diagram of the Receiver is shown in figure 10-1 and its schematic in figure 10-2.

**10-2. Down Converter.** The 10.7 MHz IF signal is converted to 455 kHz by mixing with a 10.245 MHz local oscillator. The local oscillator is phase locked to the system 10 MHz frequency standard. A sample of the 10.245 MHz VCO signal is output to the Processor I/O module. There the VCO signal is mixed with 10 MHz, the difference is divided by 49, and the result compared with a 5 kHz reference obtained from the 10 MHz. Any frequency difference causes a correction to be made to the VCO frequency via the 10.245 MHz VCO TV line through the Loop Filter.

10-3. The IF filter following the mixer provides the selectivity for the system. Two bandwidths, ± 100 kHz wideband and ± 13 kHz narrowband, are processor selectable to correspond the front panel bandwidth control.

**10-4. Linear IF Amplifier and Detectors.** The linear IF Jmplifier amplifies the 455 kHz signal to the AM and FM detectors. The DC signal from the AM detector is fed to the AGC Amplifier and Squelch Detection circuitry. There it is compared to the AGC reference with the resulting AGC signal controlling the gain of the IF Amplifier. For signal present indication and squelch operation the SQUELCH LVL from the front panel is compared to the AGC voltage. When the AGC voltage falls below the squelch level, indicating a strong signal, the SIG PRESENT line is activated. With the SIG PRESENT active the audio is allowed through the select switch and the signal present light on the front panel is illuminated. To warn the operator when the IF input level is beyond the linear range of the IF amplifier, the AGC voltage is also compared to a fixed IF overload level. When this level is exceeded, the IF OVLD line is activated causing the processor to flash the warning on the CRT display.

10-5. The AC component from the AM detector is buffered by the Audio Buffer and then passed to the Audio Select switch. The lower 3 dB corner on the AM audio response is approximately 100 Hz.

10-6. Frequency modulation is recovered by a dual bandwidth phase locked loop discriminator. The bandwidth, wide or narrow, is selected coincident with the IF Filter bandwidth. Audio from the discriminator is applied to the Audio Select switch.

10-7. A 455 kHz Buffer amplifier provides an interface between the IF Amplifier output and the IF processing circuits on the Scope/DVM Control module.

**10-8. Audio Switching and Filtering.** The output of the AM or FM detector or the SSB AUDIO signal from the Scope/DVM Control module can be selected as the demodulated audio output. Selection is made by the processor depending on the operating mode and the presence of the active state on the SIG PRESENT line. If the SIG PRESENT line is not active, the Audio Select switch is opened squelching the audio signal.

10-9. The Audio Filter provides either wide or narrow band filtering on the recovered audio. For wideband a 0.5 dB bandwidth of 100 kHz is provided while narrowband has a 0.5 dB bandwidth of 3 kHz. The output of the filter is separately buffered to three signal lines. The DEMOD CAL AUD signal is used on the Scope/DVM Control module for modulation determination, the DEMOD OUT signal goes to the front panel jack, and the VOL CNTL AUD provides the drive to the speaker audio amplifier.

**10-10. Logarithmic Amplifier and Detector.** For the spectrum analyzer function the logarithmic IF amplifier processes the input signal level over an 80 dB range. The Amplifier is composed of four 20 dB sections summed together. Amplitude detection at the output of the amplifier provides the SPECT ANA VERT signal to the Scope/DVM Control module.

**10-11. Alarm Generator and Audio Amplifier.** An astable multivibrator operating at 1.2 kHz is the Alarm Generator. The Alarm signal is controlled by the processor and is summed with the VOL CNTL AUD RTN signal at the input of the Audio Amplifier. The SPKR AUD output of the amplifier has 0.5 watt capability and is connected directly to the system speaker.

**10-12. Module Control.** Address decoding for the two control latches on this module is performed on the Synthesizer module. The two decoded lines, RF LCH ADD 13 and RF LCH ADD 14, determine which Control Latch the four bit data bus, RF DATA BUS 0-3, will be stored.

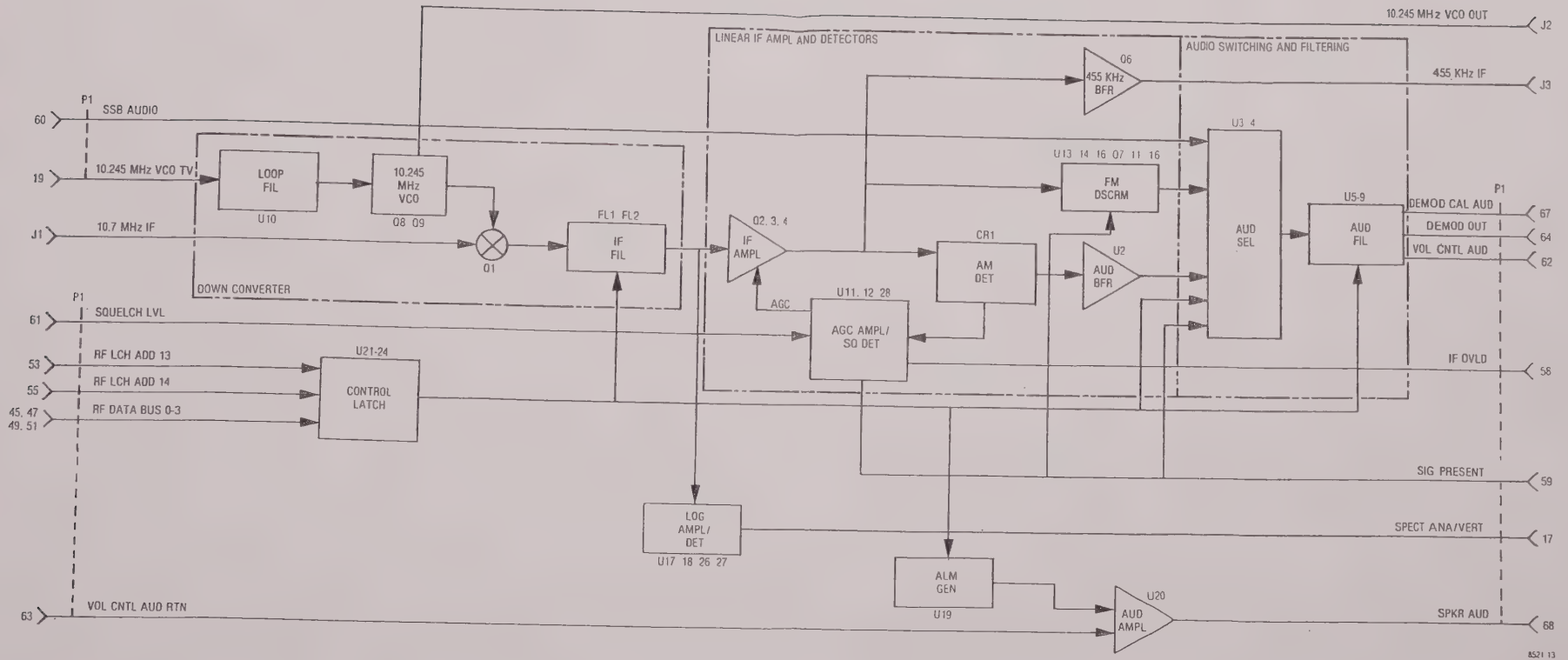



Figure 10-1. Receiver A4 Block Diagram

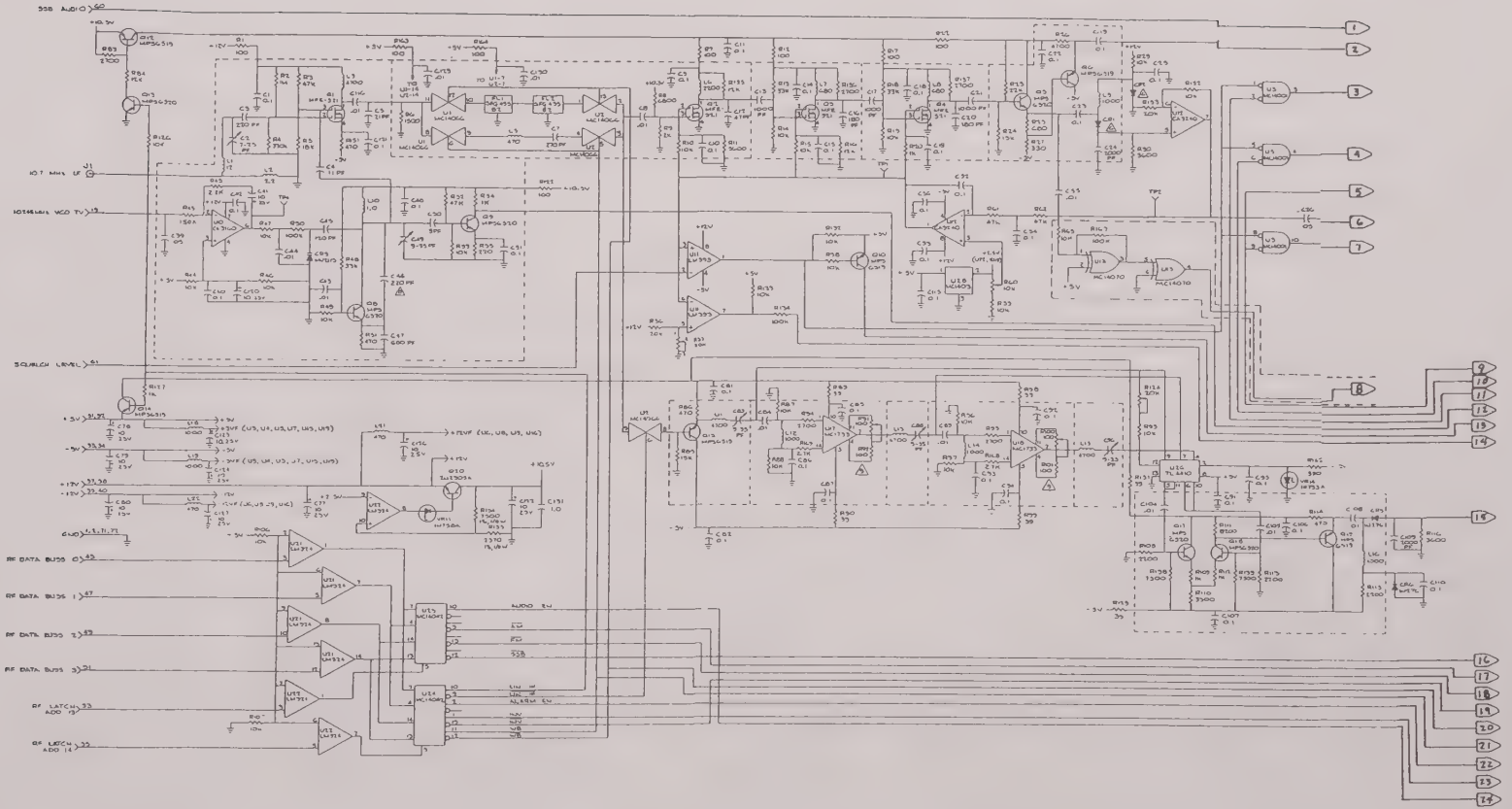


Figure 10-2. Receiver A4 Schematic Diagram (Sheet 1 of 2)

CAUTION
* CHANGES HAVE BEEN MADE
ON THIS PAGE.
SEE ISSUE SHEET.

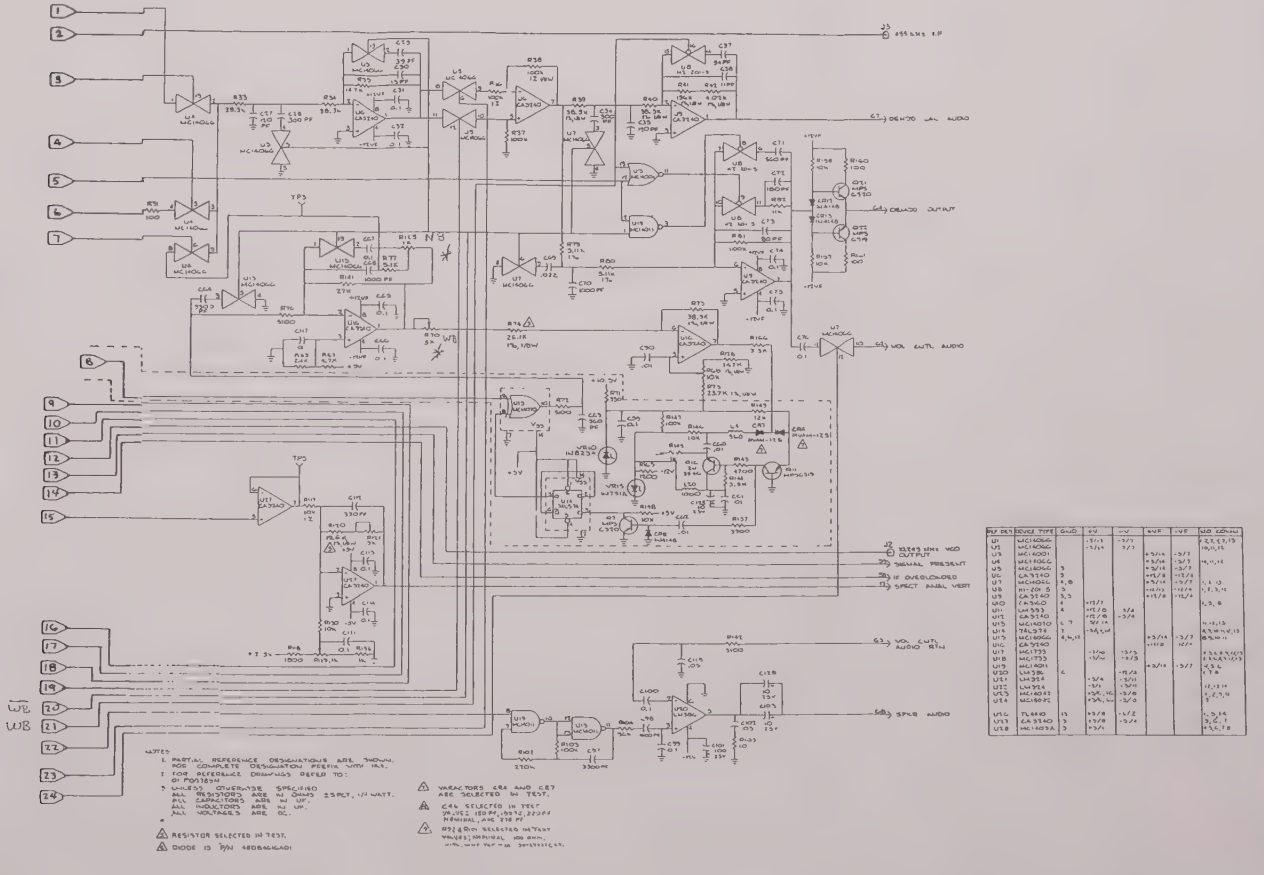


Figure 10-2. Receiver A4 Schematic Diagram (Sheet 2 of 2)

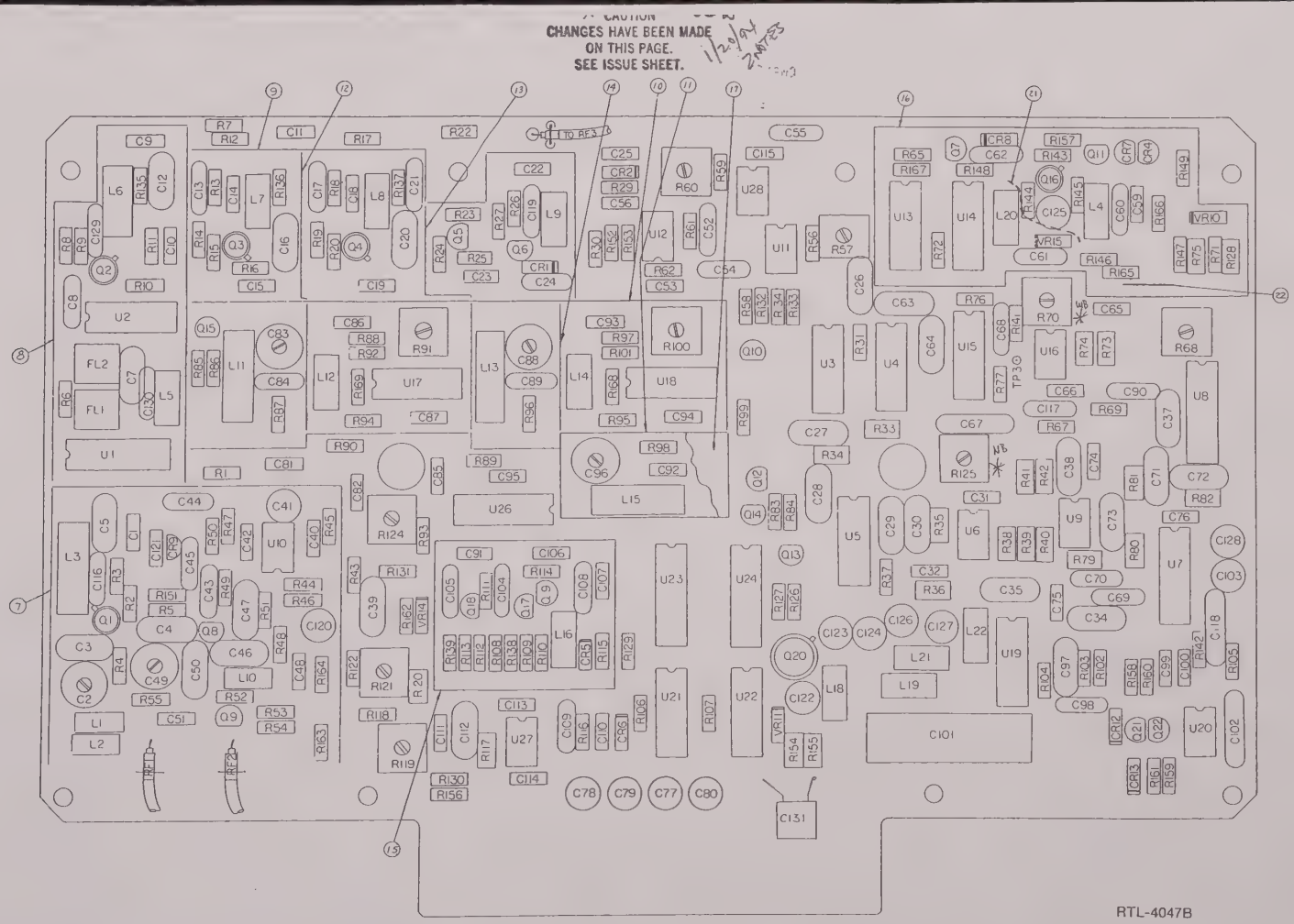



Figure 10-4. Receiver A4 PWB Parts Location Diagram (Sheet 1 of 3)

| Find No. | Qty. Req. | Part No. | Nomenclature | Part Value |
|---|---|---|---|---|
| A4 | | RTL-10028 | RECEIVER MODULE | |
| 001 | 1 | 27-80396A88 | CHASSIS,RECEIVER | |
| 003 | 1 | 15-80335A37 | COVER,DIGITAL SYNT | |
| 005 | AR | SN63WRMAP3 | SOLDER | |
| 006 | AR | 11-14157A01 | INK | BLACK |
| 007 | 10 | 03-139012 | SCREW,MACH,SEMS PH | .112-40X.250 |
| 009 | 2 | 5C84500B03 | EYELET | |
| 010 | 2 | 42C84284B01 | RETAINER | |
| 011 | 2 | 03-139581 | SCREW,PH | 4-40X.312 |
| 012 | AR | 30-84421F13 | CABLE,RF | WHT |
| 013 | AR | 30-14349A04 | CABLE | .085 |
| 014 | AR | | WIRE,BUS | #24 |
| A 001 | 1 | RTL-4047B | PWB ASSY,RECEIVER | |
| J 001 | 1 | 09-80331A77 | CONNECTOR,RF | |
| J 002 | 1 | 09-80331A77 | CONNECTOR,RF | |
| J 003 | 1 | 09-80331A79 | CONNECTOR,RF | |

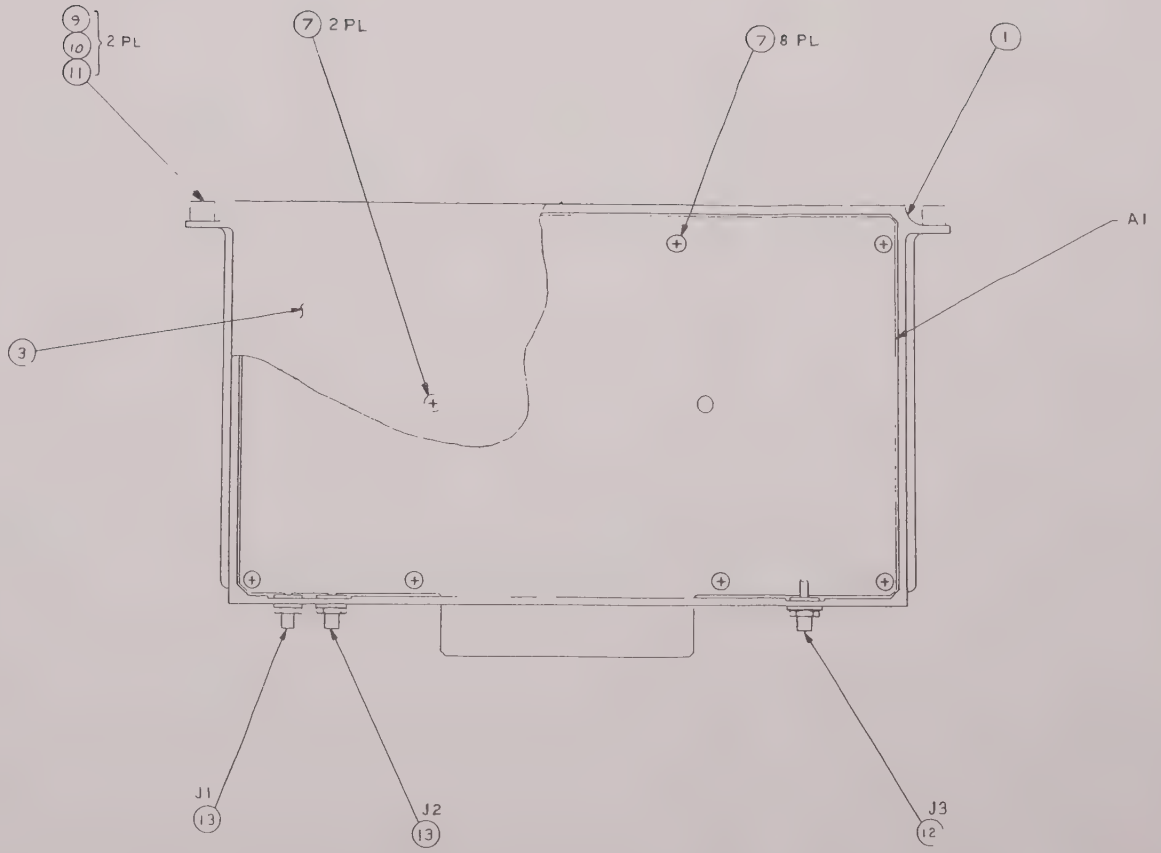



Figure 10-3. Receiver A4 (RTL-10002B) Parts Location Diagram

| Find No. | Qty. Req. | Part No. | Nomenclature | Part Value |
|---|---|---|---|---|
| 001 | 1 | 84-80335A23 | PWB,RECEIVER | |
| 005 | AR | SN63WRP3 | SOLDER | |
| 006 | AR | 11-14167A01 | INK | BLACK |
| 007 | 1 | 26-P00367N001 | SHIELD | |
| 008 | 1 | 26-P00367N002 | SHIELD | |
| 009 | 1 | 26-P00367N003 | SHIELD | |
| 010 | 1 | 26-P00367N004 | SHIELD | |
| 011 | 1 | 26-P00367N005 | SHIELD | |
| 012 | 1 | 26-P00367N006 | SHIELD | |
| 013 | 1 | 26-P00367N007 | SHIELD | |
| 014 | 1 | 26-P00367N008 | SHIELD | |
| 015 | 1 | 26-P00367N009 | SHIELD | |
| 016 | 1 | 26-P00367N010 | SHIELD | |
| 019 | 1 | 26-P00367N011 | SHIELD | |
| 021 | AR | | WIRE,TEF | #24 WHT |
| 022 | AR | | WIRE,SOLID BUS | #24 |
| C 001 | 1 | 21-80396A49 | CAPACITOR | .1UF-20-100 |
| C 002 | 1 | 20-80396A56 | CAPACITOR | 7 TO 25PF-200 |
| C 003 | 1 | 21-80396A52 | CAPACITOR | .01UF-20+80-200 |
| C 004 | 1 | 21D84494B37 | CAPACITOR | 11PF-5-500 |
| C 005 | 1 | 21D84494B40 | CAPACITOR | 21PF-5-500 |
| C 007 | 1 | 21D84494B14 | CAPACITOR | 270PF-5-500 |
| C 008 | 1 | 21-80396A52 | CAPACITOR | .01UF-20+80-200 |
| C 009 | 1 | 21-80396A49 | CAPACITOR | .1UF-20-100 |
| C 010 | 1 | 21-80396A49 | CAPACITOR | .1UF-20-100 |
| C 011 | 1 | 21-80396A49 | CAPACITOR | .1UF-20-100 |
| C 012 | 1 | 21D84494B44 | CAPACITOR | 47PF-5-500 |
| C 013 | 1 | 21-80396A51 | CAPACITOR | 1000PF-10-100 |
| C 014 | 1 | 21-80396A49 | CAPACITOR | .1UF-20-100 |
| C 015 | 1 | 21-80396A49 | CAPACITOR | .1UF-20-100 |
| C 016 | 1 | 21D84494B46 | CAPACITOR | 180PF-3-500 |
| C 017 | 1 | 21-80396A51 | CAPACITOR | 1000PF-10-100 |
| C 018 | 1 | 21-80396A49 | CAPACITOR | .1UF-20-100 |
| C 019 | 1 | 21-80396A49 | CAPACITOR | .1UF-20-100 |
| C 020 | 1 | 21D84494B46 | CAPACITOR | 180PF-3-500 |
| C 021 | 1 | 21-80396A51 | CAPACITOR | 1000PF-10-100 |
| C 022 | 1 | 21-80396A49 | CAPACITOR | .1UF-20-100 |
| C 023 | 1 | 21-80396A49 | CAPACITOR | .1UF-20-100 |
| C 024 | 1 | 21D82428B36 | CAPACITOR | 2000PF-10-200 |
| C 025 | 1 | 21-80396A49 | CAPACITOR | .1UF-20-100 |
| C 026 | 1 | 21C82372C10 | CAPACITOR | .05UF-20-25 |
| C 027 | 1 | 21D84494B06 | CAPACITOR | 120PF-5-500 |
| C 028 | 1 | 21D84494B15 | CAPACITOR | 300PF-5-500 |
| C 029 | 1 | 21D84494B24 | CAPACITOR | 39PF-5-500 |
| C 030 | 1 | 21D84494B38 | CAPACITOR | 15PF-5-500 |
| C 031 | 1 | 21-80396A49 | CAPACITOR | .1UF-20-100 |
| C 032 | 1 | 21-80396A49 | CAPACITOR | .1UF-20-100 |
| C 034 | 1 | 21D84494B15 | CAPACITOR | 300PF-5-500 |
| C 035 | 1 | 21D84494B06 | CAPACITOR | 120PF-5-500 |
| C 037 | 1 | 21D84494B30 | CAPACITOR | 34PF-5-500 |
| C 038 | 1 | 21D84494B37 | CAPACITOR | 11PF-5-500 |
| C 039 | 1 | 21C82372C10 | CAPACITOR | .05UF-20-25 |
| C 040 | 1 | 21-80396A49 | CAPACITOR | .1UF-20-100 |
| C 041 | 1 | 23-80396A40 | CAPACITOR | 10UF-25V |
| C 042 | 1 | 21-80396A49 | CAPACITOR | .1UF-20-100 |
| C 043 | 1 | 21-80396A52 | CAPACITOR | .01UF-20+80-200 |
| C 044 | 1 | 21-80396A52 | CAPACITOR | .01UF-20+80-200 |
| C 045 | 1 | 21D84494B06 | CAPACITOR | 120PF-5-500 |
| C 046 | 1 | 21D84494B12 | CAPACITOR | 220PF-5-500 NOMINA |
| 11 C 046 | S01 | 21-80369A94 | CAPACITOR | 150PF-5-500 |
| C 046 | S01 | 21-80369A95 | CAPACITOR | 180PF-5-500 |
| C 046 | S01 | 21-80369A91 | CAPACITOR | 270PF-5-300 |
| C 047 | 1 | 21K855552 | CAPACITOR | 680PF-10-500 |
| C 048 | 1 | 21-80396A49 | CAPACITOR | .1UF-20-100 |
| C 049 | 1 | 20-80396A57 | CAPACITOR | 9 TO 35PF-200 |
| C 050 | 1 | 21D84426B51 | CAPACITOR | 3PF-5-500 |
| C 051 | 1 | 21-80396A49 | CAPACITOR | .1UF-20-100 |
| C 052 | 1 | 21-80348A89 | CAPACITOR | .1UF-20-16 |
| C 053 | 1 | 21-80396A49 | CAPACITOR | .1UF-20-100 |
| C 054 | 1 | 21-80348A89 | CAPACITOR | .1UF-20-16 |
| C 055 | 1 | 21-80396A52 | CAPACITOR | .01UF-20+80-200 |
| C 056 | 1 | 21-80396A49 | CAPACITOR | .1UF-20-100 |
| C 059 | 1 | 21-80396A49 | CAPACITOR | .1UF-20-100 |
| C 060 | 1 | 21-80396A52 | CAPACITOR | .01UF-20+80-200 |
| C 061 | 1 | 21-80396A52 | CAPACITOR | .01UF-20+80-200 |
| C 062 | 1 | 21-80396A52 | CAPACITOR | .01UF-20+80-200 |
| C 063 | 1 | 21-80396A50 | CAPACITOR | 560PF-10-500 |
| C 064 | 1 | 21D82428B10 | CAPACITOR | 3300PF-10-100 |
| C 065 | 1 | 21-80396A49 | CAPACITOR | .1UF-20-100 |
| C 066 | 1 | 21-80396A49 | CAPACITOR | .1UF-20-100 |
| C 067 | 1 | 21-80370A05 | CAPACITOR | .1UF-10-100 |
| C 068 | 1 | 21-80396A51 | CAPACITOR | 1000PF-10-100 |
| C 069 | 1 | 21-80370A04 | CAPACITOR | .022UF-10-100 |
| C 070 | 1 | 21-80396A51 | CAPACITOR | 1000PF-10-100 |
| C 071 | 1 | 21-80396A50 | CAPACITOR | 560PF-10-500 |
| C 072 | 1 | 21D84494B46 | CAPACITOR | 180PF-3-500 |
| C 073 | 1 | 21D84426B21 | CAPACITOR | 80PF-5-500 |
| C 074 | 1 | 21-80396A49 | CAPACITOR | .1UF-20-100 |
| C 075 | 1 | 21-80396A49 | CAPACITOR | .1UF-20-100 |
| C 076 | 1 | 21-80396A49 | CAPACITOR | .1UF-20-100 |
| C 077 | 1 | 23-80396A40 | CAPACITOR | 10UF-25V |
| C 078 | 1 | 23-80396A40 | CAPACITOR | 10UF-25V |
| C 079 | 1 | 23-80396A40 | CAPACITOR | 10UF-25V |
| C 080 | 1 | 23-80396A40 | CAPACITOR | 10UF-25V |
| C 081 | 1 | 21-80396A49 | CAPACITOR | .1UF-20-100 |
| C 082 | 1 | 21-80396A49 | CAPACITOR | .1UF-20-100 |
| C 083 | 1 | 20-80396A57 | CAPACITOR | 9 TO 35PF-200 |
| C 084 | 1 | 21-80396A52 | CAPACITOR | .01UF-20+80-200 |
| C 085 | 1 | 21-80396A49 | CAPACITOR | .1UF-20-100 |
| C 086 | 1 | 21-80396A49 | CAPACITOR | .1UF-20-100 |
| C 087 | 1 | 21-80396A49 | CAPACITOR | .1UF-20-100 |
| C 088 | 1 | 20-80396A57 | CAPACITOR | 9 TO 35PF-200 |
| C 089 | 1 | 21-80396A52 | CAPACITOR | .01UF-20+80-200 |
| C 090 | 1 | 21-80396A52 | CAPACITOR | .01UF-20+80-200 |
| C 091 | 1 | 21-80396A49 | CAPACITOR | .1UF-20-100 |
| C 092 | 1 | 21-80396A49 | CAPACITOR | .1UF-20-100 |
| C 093 | 1 | 21-80396A49 | CAPACITOR | .1UF-20-100 |
| C 094 | 1 | 21-80396A49 | CAPACITOR | .1UF-20-100 |
| C 095 | 1 | 21-80396A49 | CAPACITOR | .1UF-20-100 |
| C 096 | 1 | 20-80396A57 | CAPACITOR | 9 TO 35PF-200 |
| C 097 | 1 | 21D82428B10 | CAPACITOR | 3300PF-10-100 |
| C 098 | 1 | 21-80396A51 | CAPACITOR | 1000PF-10-100 |
| C 099 | 1 | 21-80396A49 | CAPACITOR | .1UF-20-100 |
| C 100 | 1 | 21-80396A49 | CAPACITOR | .1UF-20-100 |
| C 101 | 1 | 23-80396A42 | CAPACITOR | 100UF-25V |
| C 102 | 1 | 21C82372C10 | CAPACITOR | .05UF-20-25 |
| C 103 | 1 | 23-80396A40 | CAPACITOR | 10UF-25V |
| C 104 | 1 | 21-80396A52 | CAPACITOR | .01UF-20+80-200 |
| C 105 | 1 | 21-80396A52 | CAPACITOR | .01UF-20+80-200 |
| C 106 | 1 | 21-80396A49 | CAPACITOR | .1UF-20-100 |
| C 107 | 1 | 21-80396A49 | CAPACITOR | .1UF-20-100 |
| C 108 | 1 | 21-80396A52 | CAPACITOR | .01UF-20+80-200 |
| C 109 | 1 | 21D82428B36 | CAPACITOR | 2000PF-10-200 |
| C 110 | 1 | 21-80396A49 | CAPACITOR | .1UF-20-100 |
| C 111 | 1 | 21-80396A49 | CAPACITOR | .1UF-20-100 |
| C 112 | 1 | 21D84494B16 | CAPACITOR | 330PF-5-500 |
| C 113 | 1 | 21-80396A49 | CAPACITOR | .1UF-20-100 |
| C 114 | 1 | 21-80396A49 | CAPACITOR | .1UF-20-100 |
| C 115 | 1 | 21-80396A49 | CAPACITOR | .1UF-20-100 |
| C 116 | 1 | 21-80396A52 | CAPACITOR | .01UF-20+80-200 |
| C 117 | 1 | 21-80396A52 | CAPACITOR | .01UF-20+80-200 |
| C 118 | 1 | 21C82372C10 | CAPACITOR | .05UF-20-25 |
| C 119 | 1 | 21-80396A52 | CAPACITOR | .01UF-20+80-200 |
| C 120 | 1 | 23-80396A40 | CAPACITOR | 10UF-25V |
| C 121 | 1 | 21-80396A49 | CAPACITOR | .1UF-20-100 |
| C 122 | 1 | 23-80396A40 | CAPACITOR | 10UF-25V |
| C 123 | 1 | 23-80396A40 | CAPACITOR | 10UF-25V |
| C 124 | 1 | 23-80396A40 | CAPACITOR | 10UF-25V |
| C 125 | 1 | 23-80396A40 | CAPACITOR | 10UF-25V |
| C 126 | 1 | 23-80396A40 | CAPACITOR | 10UF-25V |
| C 127 | 1 | 23-80396A40 | CAPACITOR | 10UF-25V |
| C 128 | 1 | 23-80396A40 | CAPACITOR | 10UF-25V |
| C 129 | 1 | 21-80396A52 | CAPACITOR | .01UF-20+80-200 |
| C 130 | 1 | 21-80396A52 | CAPACITOR | .01UF-20+80-200 |
| C 131 | 1 | 23-80369A59 | CAPACITOR | 1UF-20-50 |
| CR001 | 1 | 48D84616A01 | DIODE | |
| CR002 | 1 | 48D84616A01 | DIODE | |
| CR004 | S01 | 48-80369A02 | VARACTOR | MVAM-125 SCREENED |
| CR004 | S01 | 48-80369A03 | VARACTOR | MVAM-125 SCREENED |
| CR004 | S01 | 48-80369A04 | VARACTOR | MVAM-125 SCREENED |
| CR004 | S01 | 48-80369A05 | VARACTOR | MVAM-125 SCREENED |
| CR005 | 1 | 48-83192A09 | DIODE | |
| CR006 | 1 | 48-83192A09 | DIODE | |
| CR007 | S01 | 48-80369A02 | VARACTOR | MVAM-125 SCREENED |
| CR007 | S01 | 48-80369A03 | VARACTOR | MVAM-125 SCREENED |
| CR007 | S01 | 48-80369A04 | VARACTOR | MVAM-125 SCREENED |
| CR007 | S01 | 48-80369A05 | VARACTOR | MVAM-125 SCREENED |
| CR008 | 1 | 48-84463K02 | DIODE | |
| CR009 | 1 | 48-80345A75 | DIODE,VARACTOR | |
| CR012 | 1 | 48-84463K02 | DIODE | |
| CR013 | 1 | 48-84463K02 | DIODE | |
| FL001 | 1 | 48-80396A30 | FILTER,CERAMIC | |
| FL002 | 1 | 48-80396A30 | FILTER,CERAMIC | |
| L 001 | 1 | 24-80369A30 | COIL | 12UH |
| L 002 | 1 | 24-80369A17 | COIL | 2.2UH |
| L 003 | 1 | 24-80369A44 | COIL | 4700UH |
| L 004 | 1 | 24-80369A40 | COIL | 560UH |
| L 005 | 1 | 24-80348A83 | COIL | 470UH |
| L 006 | 1 | 24-80369A43 | COIL | 2200UH |
| L 007 | 1 | 24-80369A41 | COIL | 680UH |
| L 008 | 1 | 24-80369A41 | COIL | 680UH |
| L 009 | 1 | 24-80369A42 | COIL | 1000UH |
| L 010 | 1 | 24-80369A18 | COIL | 1UH |
| L 011 | 1 | 24-80369A44 | COIL | 4700UH |
| L 012 | 1 | 24-80369A42 | COIL | 1000UH |
| L 013 | 1 | 24-80369A44 | COIL | 4700UH |
| L 014 | 1 | 24-80369A42 | COIL | 1000UH |
| L 015 | 1 | 24-80369A44 | COIL | 4700UH |
| L 016 | 1 | 24-80369A42 | COIL | 1000UH |
| L 018 | 1 | 24-80369A42 | COIL | 1000UH |
| L 019 | 1 | 24-80369A42 | COIL | 1000UH |
| L 020 | 1 | 24-80369A42 | COIL | 1000UH |
| L 021 | 1 | 24-80348A83 | COIL | 470UH |
| L 022 | 1 | 24-80348A83 | COIL | 470UH |
| Q 001 | 1 | 48-80345A42 | TRANSISTOR | |
| Q 002 | 1 | 48-80345A42 | TRANSISTOR | |
| Q 003 | 1 | 48-80345A42 | TRANSISTOR | |
| Q 004 | 1 | 48-80345A42 | TRANSISTOR | |
| Q 005 | 1 | 48-80368A91 | TRANSISTOR | MPS6520 SCREENED |
| Q 006 | 1 | 48-80368A92 | TRANSISTOR | MPS6519 SCREENED |
| Q 007 | 1 | 48-80368A91 | TRANSISTOR | MPS6520 SCREENED |
| Q 008 | 1 | 48-80368A91 | TRANSISTOR | MPS6520 SCREENED |
| Q 009 | 1 | 48-80368A91 | TRANSISTOR | MPS6520 SCREENED |
| Q 010 | 1 | 48-80368A92 | TRANSISTOR | MPS6519 SCREENED |
| Q 011 | 1 | 48-80368A92 | TRANSISTOR | MPS6519 SCREENED |
| Q 012 | 1 | 48-80368A92 | TRANSISTOR | MPS6519 SCREENED |
| Q 013 | 1 | 48-80368A91 | TRANSISTOR | MPS6520 SCREENED |
| Q 014 | 1 | 48-80368A92 | TRANSISTOR | MPS6519 SCREENED |
| Q 015 | 1 | 48-80368A92 | TRANSISTOR | MPS6519 SCREENED |
| Q 016 | 1 | 48-83827D31 | TRANSISTOR | |

Figure 10-4. Receiver A4PWB Parts Location Diagram (Sheet 2 of 3)

| Find No. | Qty. Req. | Part No. | Nomenclature | Part Value |
|---|---|---|---|---|
| Q 017 | 1 | 48-80368A91 | TRANSISTOR | MPS6520 SCREENED |
| Q 018 | 1 | 48-80368A91 | TRANSISTOR | MPS6520 SCREENED |
| Q 019 | 1 | 48-80368A92 | TRANSISTOR | MPS6519 SCREENED |
| Q 020 | 1 | 48-869145 | TRANSISTOR | |
| Q 021 | 1 | 48-80368A91 | TRANSISTOR | MPS6520 SCREENED |
| Q 022 | 1 | 48-80368A92 | TRANSISTOR | MPS6519 SCREENED |
| R 001 | 1 | 6S124A25 | RESISTOR | 100-5-1/4 |
| R 002 | 1 | 6S124B22 | RESISTOR | 1M-5-1/4 |
| R 003 | 1 | 6S124A89 | RESISTOR | 47K-5-1/4 |
| R 004 | 1 | 6S124B10 | RESISTOR | 330K-5-1/4 |
| R 005 | 1 | 6S124A79 | RESISTOR | 18K-5-1/4 |
| R 006 | 1 | 6S124A53 | RESISTOR | 1.5K-5-1/4 |
| R 007 | 1 | 6S124A25 | RESISTOR | 100-5-1/4 |
| R 008 | 1 | 6S124A69 | RESISTOR | 6.8K-5-1/4 |
| R 009 | 1 | 6S124A56 | RESISTOR | 2.0K-5-1/4 |
| R 010 | 1 | 6S124A73 | RESISTOR | 10K-5-1/4 |
| R 011 | 1 | 6S124A67 | RESISTOR | 5.6K-5-1/4 |
| R 012 | 1 | 6S124A25 | RESISTOR | 100-5-1/4 |
| R 013 | 1 | 6S124A85 | RESISTOR | 33K-5-1/4 |
| R 014 | 1 | 6S124A73 | RESISTOR | 10K-5-1/4 |
| R 015 | 1 | 6S124A73 | RESISTOR | 10K-5-1/4 |
| R 016 | 1 | 6S124A75 | RESISTOR | 12K-5-1/4 |
| R 017 | 1 | 6S124A25 | RESISTOR | 100-5-1/4 |
| R 018 | 1 | 6S124A85 | RESISTOR | 33K-5-1/4 |
| R 019 | 1 | 6S124A73 | RESISTOR | 10K-5-1/4 |
| R 020 | 1 | 6S124A49 | RESISTOR | 1K-5-1/4 |
| R 022 | 1 | 6S124A25 | RESISTOR | 100-5-1/4 |
| R 023 | 1 | 6S124A81 | RESISTOR | 22K-5-1/4 |
| R 024 | 1 | 6S124A77 | RESISTOR | 15K-5-1/4 |
| R 025 | 1 | 6S124A45 | RESISTOR | 680-5-1/4 |
| R 026 | 1 | 6S124A65 | RESISTOR | 4.7K-5-1/4 |
| R 027 | 1 | 6S124A37 | RESISTOR | 330-5-1/4 |
| R 029 | 1 | 6S124A73 | RESISTOR | 10K-5-1/4 |
| R 030 | 1 | 6S124A62 | RESISTOR | 3.6K-5-1/4 |
| R 031 | 1 | 6S124A25 | RESISTOR | 100-5-1/4 |
| R 033 | 1 | 06-10621D48 | RESISTOR | 38.3K-1-1/8 |
| R 034 | 1 | 06-10621D48 | RESISTOR | 38.3K-1-1/8 |
| R 035 | 1 | 06-10621E05 | RESISTOR | 147K-1-1/8 |
| R 036 | 1 | 06-10621D88 | RESISTOR | 100K-1-1/8 |
| R 037 | 1 | 6S124A97 | RESISTOR | 100K-5-1/4 |
| R 038 | 1 | 06-10621D88 | RESISTOR | 100K-1-1/8 |
| R 039 | 1 | 06-10621D48 | RESISTOR | 38.3K-1-1/8 |
| R 040 | 1 | 06-10621D48 | RESISTOR | 38.3K-1-1/8 |
| R 041 | 1 | 06-10621E17 | RESISTOR | 196K-1-1/8 |
| R 042 | 1 | 06-10621C53 | RESISTOR | 4020-1-1/8 |
| R 043 | 1 | 6S124B02 | RESISTOR | 150K-5-1/4 |
| R 044 | 1 | 6S124A73 | RESISTOR | 10K-5-1/4 |
| R 045 | 1 | 6S124A57 | RESISTOR | 2.2K-5-1/4 |
| R 046 | 1 | 6S124A73 | RESISTOR | 10K-5-1/4 |
| R 047 | 1 | 6S124A73 | RESISTOR | 10K-5-1/4 |
| R 048 | 1 | 6S124A85 | RESISTOR | 33K-5-1/4 |
| R 049 | 1 | 6S124A73 | RESISTOR | 10K-5-1/4 |
| R 050 | 1 | 6S124A97 | RESISTOR | 100K-5-1/4 |
| R 051 | 1 | 6S124A41 | RESISTOR | 470-5-1/4 |
| R 052 | 1 | 6S124A89 | RESISTOR | 47K-5-1/4 |
| R 053 | 1 | 6S124A73 | RESISTOR | 10K-5-1/4 |
| R 054 | 1 | 6S124A49 | RESISTOR | 1K-5-1/4 |
| R 055 | 1 | 6S124A33 | RESISTOR | 220-5-1/4 |
| R 056 | 1 | 6S124A80 | RESISTOR | 20K-5-1/4 |
| R 057 | 1 | 18D83452F15 | RESISTOR,VARIABLE | 20K |
| R 058 | 1 | 6S124A73 | RESISTOR | 10K-5-1/4 |
| R 059 | 1 | 6S124A73 | RESISTOR | 10K-5-1/4 |
| R 060 | 1 | 18D83452F14 | RESISTOR,VARIABLE | 10K |
| R 061 | 1 | 6S124A89 | RESISTOR | 47K-5-1/4 |
| R 062 | 1 | 6S124A89 | RESISTOR | 47K-5-1/4 |
| R 065 | 1 | 6S124A73 | RESISTOR | 10K-5-1/4 |
| R 067 | 1 | 6S124A65 | RESISTOR | 4.7K-5-1/4 |
| R 068 | 1 | 18D83452F14 | RESISTOR,VARIABLE | 10K |
| R 069 | 1 | 6S124A58 | RESISTOR | 2.4K-5-1/4 |
| R 070 | 1 | 18D83452F12 | RESISTOR,VARIABLE | 5K |
| R 071 | 1 | 6S124A37 | RESISTOR | 330-5-1/4 |
| R 072 | 1 | 6S124A66 | RESISTOR | 5.1K-5-1/4 |
| R 073 | 1 | 06-10621D48 | RESISTOR | 38.3K-1-1/8 |
| R 074 | 1 | 06-10621D32 | RESISTOR | 26.1K-1-1/8 NOMINA |
| R 074 | S01 | 06-10621D24 | RESISTOR | 21.5K-1-1/8 |
| R 074 | S01 | 06-10621D36 | RESISTOR | 28.7K-1-1/8 |
| R 075 | 1 | 06-10621D28 | RESISTOR | 23.7K-1-1/8 |
| R 076 | 1 | 6S124A66 | RESISTOR | 5.1K-5-1/4 |
| R 077 | 1 | 6S124A66 | RESISTOR | 5.1K-5-1/4 |
| R 079 | 1 | 06D83175C83 | RESISTOR | 5.11K-1-1/4 |
| R 080 | 1 | 06D83175C83 | RESISTOR | 5.11K-1-1/4 |
| R 081 | 1 | 06-10621D88 | RESISTOR | 100K-1-1/8 |
| R 082 | 1 | 06D83175C05 | RESISTOR | 11K-1-1/4 |
| R 083 | 1 | 6S124A59 | RESISTOR | 2.7K-5-1/4 |
| R 084 | 1 | 6S124A75 | RESISTOR | 12K-5-1/4 |
| R 085 | 1 | 6S124A77 | RESISTOR | 15K-5-1/4 |
| R 086 | 1 | 6S124A41 | RESISTOR | 470-5-1/4 |
| R 087 | 1 | 6S124A73 | RESISTOR | 10K-5-1/4 |
| R 088 | 1 | 6S124A73 | RESISTOR | 10K-5-1/4 |
| R 089 | 1 | 6S124A15 | RESISTOR | 39-5-1/4 |
| R 090 | 1 | 6S124A15 | RESISTOR | 39-5-1/4 |
| R 091 | 1 | 18D83452F04 | RESISTOR,VARIABLE | 100 |
| R 092 | 1 | 6S124A25 | RESISTOR | 100-5-1/4 |
| R 092 | S01 | | WIRE,TEF | #24 WHT |
| R 093 | 1 | 6S124A73 | RESISTOR | 10K-5-1/4 |
| R 094 | 1 | 6S124A59 | RESISTOR | 2.7K-5-1/4 |
| R 095 | 1 | 6S124A59 | RESISTOR | 2.7K-5-1/4 |
| R 096 | 1 | 6S124A73 | RESISTOR | 10K-5-1/4 |
| R 097 | 1 | 6S124A73 | RESISTOR | 10K-5-1/4 |
| R 098 | 1 | 6S124A15 | RESISTOR | 39-5-1/4 |
| R 099 | 1 | 6S124A15 | RESISTOR | 39-5-1/4 |
| R 100 | 1 | 18D83452F04 | RESISTOR,VARIABLE | 100 |
| R 101 | 1 | 6S124A25 | RESISTOR | 100-5-1/4 |
| R 101 | S01 | | WIRE,TEF | #24 WHT |
| R 102 | 1 | 6S124B06 | RESISTOR | 220K-5-1/4 |
| R 103 | 1 | 6S124A97 | RESISTOR | 100K-5-1/4 |
| R 104 | 1 | 6S124A91 | RESISTOR | 56K-5-1/4 |
| R 105 | 1 | 6S124A01 | RESISTOR | 10-5-1/4 |
| R 106 | 1 | 6S124A73 | RESISTOR | 10K-5-1/4 |
| R 107 | 1 | 6S124A73 | RESISTOR | 10K-5-1/4 |
| R 108 | 1 | 6S124A57 | RESISTOR | 2.2K-5-1/4 |
| R 109 | 1 | 6S124A49 | RESISTOR | 1K-5-1/4 |
| R 110 | 1 | 6S124A61 | RESISTOR | 3.3K-5-1/4 |
| R 111 | 1 | 6S124A71 | RESISTOR | 8.2K-5-1/4 |
| R 112 | 1 | 6S124A49 | RESISTOR | 1K-5-1/4 |
| R 113 | 1 | 6S124A57 | RESISTOR | 2.2K-5-1/4 |
| R 114 | 1 | 6S124A41 | RESISTOR | 470-5-1/4 |
| R 115 | 1 | 6S124A57 | RESISTOR | 2.2K-5-1/4 |
| R 116 | 1 | 6S124A62 | RESISTOR | 3.6K-5-1/4 |
| R 117 | 1 | 06D83175C03 | RESISTOR | 10K-1-1/4 |
| R 118 | 1 | 6S124A55 | RESISTOR | 1.8K-5-1/4 |
| R 119 | 1 | 18D83452F10 | RESISTOR,VARIABLE | 1K |
| R 120 | S01 | 06-10621D28 | RESISTOR | 23.7K-1-1/8 |
| R 120 | 1 | 06-10621D20 | RESISTOR | 19.6K-1-1/8 NOMINA |
| R 120 | S01 | 06-10621D36 | RESISTOR | 28.7K-1-1/8 |
| R 120 | S01 | 06-10621D32 | RESISTOR | 26.1K-1-1/8 |
| R 121 | 1 | 18D83452F12 | RESISTOR,VARIABLE | 5K |
| R 122 | 1 | 6S124A25 | RESISTOR | 100-5-1/4 |
| R 124 | 1 | 18D83452F16 | RESISTOR,VARIABLE | 20K |
| R 125 | 1 | 18D83452F10 | RESISTOR,VARIABLE | 1K |
| R 126 | 1 | 6S124A73 | RESISTOR | 10K-5-1/4 |
| R 127 | 1 | 6S124A49 | RESISTOR | 1K-5-1/4 |
| R 128 | 1 | 06-10621D08 | RESISTOR | 14.7K-1-1/18 |
| R 129 | 1 | 6S124A15 | RESISTOR | 39-5-1/4 |
| R 130 | 1 | 6S124A73 | RESISTOR | 10K-5-1/4 |
| R 131 | 1 | 6S124A15 | RESISTOR | 39-5-1/4 |
| R 132 | 1 | 6S124A73 | RESISTOR | 10K-5-1/4 |
| R 133 | 1 | 6S124A73 | RESISTOR | 10K-5-1/4 |
| R 134 | 1 | 6S124A97 | RESISTOR | 100K-5-1/4 |
| R 135 | 1 | 6S124A75 | RESISTOR | 12K-5-1/4 |
| R 136 | 1 | 6S124A59 | RESISTOR | 2.7K-5-1/4 |
| R 137 | 1 | 6S124A59 | RESISTOR | 2.7K-5-1/4 |
| R 138 | 1 | 6S124A70 | RESISTOR | 7.5K-5-1/4 |
| R 139 | 1 | 6S124A70 | RESISTOR | 7.5K-5-1/4 |
| R 141 | 1 | 6S124A83 | RESISTOR | 27K-5-1/4 |
| R 142 | 1 | 6S124A66 | RESISTOR | 5.1K-5-1/4 |
| R 143 | 1 | 6S124A65 | RESISTOR | 4.7K-5-1/4 |
| R 144 | 1 | 6S124A61 | RESISTOR | 3.3K-5-1/4 |
| R 145 | 1 | 6S124A49 | RESISTOR | 1K-5-1/4 |
| R 146 | 1 | 6S124A73 | RESISTOR | 10K-5-1/4 |
| R 147 | 1 | 6S124A97 | RESISTOR | 100K-5-1/4 |
| R 148 | 1 | 6S124A73 | RESISTOR | 10K-5-1/4 |
| R 149 | 1 | 6S124A75 | RESISTOR | 12K-5-1/4 |
| R 151 | 1 | 6S124A41 | RESISTOR | 470-5-1/4 |
| R 152 | 1 | 6S124A73 | RESISTOR | 10K-5-1/4 |
| R 153 | 1 | 6S124A80 | RESISTOR | 20K-5-1/4 |
| R 154 | 1 | 06-10621C79 | RESISTOR | 7500-1-1/8 |
| R 155 | 1 | 06-10621C31 | RESISTOR | 2370-1-1/8 |
| R 156 | 1 | 6S124A49 | RESISTOR | 1K-5-1/4 |
| R 157 | 1 | 6S124A61 | RESISTOR | 3.3K-5-1/4 |
| R 158 | 1 | 6S124A73 | RESISTOR | 10K-5-1/4 |
| R 159 | 1 | 6S124A73 | RESISTOR | 10K-5-1/4 |
| R 160 | 1 | 6S124A25 | RESISTOR | 100-5-1/4 |
| R 161 | 1 | 6S124A25 | RESISTOR | 100-5-1/4 |
| R 162 | 1 | 6S124A39 | RESISTOR | 390-5-1/4 |
| R 163 | 1 | 6S124A25 | RESISTOR | 100-5-1/4 |
| R 164 | 1 | 6S124A25 | RESISTOR | 100-5-1/4 |
| R 165 | 1 | 6S124A51 | RESISTOR | 1.2K-5-1/4 |
| R 166 | 1 | 6S124A61 | RESISTOR | 3.3K-5-1/4 |
| R 167 | 1 | 6S185A97 | RESISTOR | 100K-5-1/8 |
| R 168 | 1 | 6S185A59 | RESISTOR | 2.7K-5-1/8 |
| R 169 | 1 | 6S185A59 | RESISTOR | 2.7K-5-1/8 |
| U 001 | 1 | 51-82884L48 | INTEGRATED CIRCUIT | MC14066BCP SCREENE |
| U 002 | 1 | 51-82884L48 | INTEGRATED CIRCUIT | MC14066BCP SCREENE |
| U 003 | 1 | 51-80368A56 | INTEGRATED CIRCUIT | MC14001BCP SCREENE |
| U 004 | 1 | 51-82884L48 | INTEGRATED CIRCUIT | MC14066BCP SCF |
| U 005 | 1 | 51-82884L48 | INTEGRATED CIRCUIT | MC14066BCP SCI |
| U 006 | 1 | 51-80345A04 | INTEGRATED CIRCUIT | CA3240E SCREENED |
| U 007 | 1 | 51-82884L48 | INTEGRATED CIRCUIT | MC14066BCP SCREENE |
| U 008 | 1 | 51-80345A05 | INTEGRATED CIRCUIT | HI-201-5 SCREENED |
| U 009 | 1 | 51-80345A04 | INTEGRATED CIRCUIT | CA3240E SCREENED |
| U 010 | 1 | 51-80345A02 | INTEGRATED CIRCUIT | CA3160E SCREENED |
| U 011 | 1 | 51-80345A10 | INTEGRATED CIRCUIT | LM393N SCREENED |
| U 012 | 1 | 51-80345A04 | INTEGRATED CIRCUIT | CA3240E SCREENED |
| U 013 | 1 | 51-80368A42 | INTEGRATED CIRCUIT | MC14070BCP SCREENE |
| U 014 | 1 | 51-80368A24 | INTEGRATED CIRCUIT | SN74LS74NS SCREENE |
| U 015 | 1 | 51-82884L48 | INTEGRATED CIRCUIT | MC14066BCP SCREENE |
| U 016 | 1 | 51-80345A04 | INTEGRATED CIRCUIT | CA3240E SCREENED |
| U 017 | 1 | 51-80345A23 | INTEGRATED CIRCUIT | MC1733CP SCREENED |
| U 018 | 1 | 51-80345A23 | INTEGRATED CIRCUIT | MC1733CP SCREENED |
| U 019 | 1 | 51-80368A32 | INTEGRATED CIRCUIT | MC14011BCP SCREENE |
| U 020 | 1 | 51-80345A09 | INTEGRATED CIRCUIT | LM386N SCREENED |
| U 021 | 1 | 51-80396A16 | INTEGRATED CIRCUIT | LM324N SCREENED |
| U 022 | 1 | 51-80396A16 | INTEGRATED CIRCUIT | LM324N SCREENED |
| U 023 | 1 | 51-80368A58 | INTEGRATED CIRCUIT | MC14042B SCREENED |
| U 024 | 1 | 51-80368A58 | INTEGRATED CIRCUIT | MC14042B SCREENED |
| U 026 | 1 | 51-80368A65 | AMPLIFIER | TL441C SCREENED |
| U 027 | 1 | 51-80345A04 | INTEGRATED CIRCUIT | CA3240E SCREENED |
| U 028 | 1 | 51-80368A66 | INTEGRATED CIRCUIT | MC1403U SCREENED |
| VR010 | 1 | 48-80368A98 | DIODE,ZENER | 6.2V-5-.4 |
| VR011 | 1 | 48-82256C11 | DIODE,ZENER | 10V-5-.4 |
| VR014 | 1 | 48-84302A09 | DIODE,ZENER | 6.2V-5-.4 |
| VR015 | 1 | 48-86850C13 | DIODE,ZENER | 5.1V-5-.4 |

Figure 10-4.
Receiver A4 PWB Parts
Location Diagram
(Sheet 3 of 3)

# SECTION 11
# RF SYNTHESIZER (A5)

**11-1. General.** The RF Synthesizer provides an RF signal source for the frequency range from 10 kHz to 1 GHz in 100 Hz steps. The output frequency is programmed by the processor through the RF control bus and is phase locked to the 10 MHz frequency standard. A reference divider in the module produces outputs of 500 kHz, 50 kHz, 5 kHz, 1 kHz, 100 Hz, and 50 Hz (SYNTH SWP SYNC) each having the same accuracy as the frequency standard. A block diagram of the RF Synthesizer is shown in figure 11-1 and its schematic is shown in figure 11-3.

**11-2. Frequency Synthesis Scheme.** Four phase locked loops are used to generate the output frequency; a 60.5 MHz loop, a 310-440 MHz loop, the 500 MHz-1000 MHz loop, and the 550 MHz loop. Two of these loops contain programmable dividers, controlled by the microprocessor for varying the frequency. The 310-440 MHz loop is controlled by the four most significant digits of the required frequency and operates in discrete 50 kHz increments. The 60.5 MHz loop is controlled by the three least significant digits of the required frequency and operates in discrete 50 Hz increments.

11-3. The output is derived from three sources, covering the ranges of 10 kHz to 250 MHz, 250 MHz to 500 MHz, and 500 MHz to 1000 MHz. In the first range, 10 kHz to 250 MHz, the output is derived by mixing the fixed 550 MHz signal with 500-1000 MHz signal programmed for frequencies from 550.01 MHz to 800 MHz. For the second range, 250 to 500 MHz, the output is a divide by two of the 500-1000 MHz signal. The final range is the 500-1000 MHz signal directly. The appropriate frequency source is switched to the SYNTH RF output of the Output Select switch.

11-4. A basic flow diagram for programming the RF Synthesizer is shown in figure 11-2. This diagram includes generate and monitor considerations, wideband amplifier control, and modulation control.

**11-5. 310-440 MHz Phase Locked Loop.** A single 310-440 MHz VCO is phase locked to the 100 kHz reference input using a straight forward loop. The VCO output is divided down to 50 kHz using a programmable two modulus prescaler and divider. Programming of the divider is controlled by the processor to give output frequencies from 310 to 440 MHz in 50 kHz steps.

**11-6. 60.5 MHz Phase Locked Loop.** The 60.5 MHz loop is programmable over a $\pm$100 kHz range in 50 Hz increments. The 60.5 MHz VCO output is mixed with a 50 MHz signal from the 550 MHz loop. A programmable divider following the mixer divides the 10.5 MHz $\pm$100 kHz signal down to the 50 Hz reference frequency. A comparison between the divider output and the reference signal by the Phase/Frequency detector results in an error voltage to the VCO which maintains the phase lock.

**11-7. 550 MHz Phase Locked Loop.** A fixed frequency of 550 MHz is obtained by dividing the 550 MHz VCO by 55 to obtain 10 MHz. The 10 MHz from the divider is compared with the 10 MHz frequency standard in the Phase/Frequency Detector. The resulting error signal is filtered and used to correct the 550 MHz VCO to maintain it in lock.

11-8. A Voltage Controlled Attenuator (VCA) follows the 550 MHz output to level the generator output for frequencies below 1 MHz. The leveling loop in the RF input module provides the ALC VOLT control signal to maintain the required output level at the front panel RF jack. See paragraph 5-31 for a further description of output leveling.

**11-9. 500-1000 MHz Phase Locked Loop.** The 500-1000 MHz output is locked to either the sum or the difference of the 310-440 MHz and 60.5 MHz loop output frequencies. In the locked condition, mixing the divide by two output of the 500-1000 MHz VCO's with the 310-440 MHz signal gives a difference frequency equal to the 60.5 MHz output. There are two frequencies at the divide by two output, the 310-440 MHz frequency plus or minus the 60.5 frequency, which will mix down to the correct frequency. However, the sense of the loop is inverted for one compared to the other. Thus the phase switch following the Phase/Frequency Detector determines at which frequency the loop will lock.

**11-10. Modulation Control.** Modulation of the tuning voltage for the 60.5 MHz VCO provides the frequency modulation of the RF output. Since the modulation sensitivity changes by a factor of two when the 250-500 MHz source is selected, the modulation control provides programmable gain control to maintain constant sensitivity at the FM MOD and SWEEP inputs. Additionally, the wideband modulation mode requires a gain of four beyond that for the narrowband mode. Thus under the control of the processor the Modulation Control selects between the SWEEP and FM MOD inputs, provides gains of 1, 2, 4, and 8 for the FM MOD input and gains of 1 and 2 for the SWEEP input Input modulation sensitivities are 5 kHz/volt and 20 kHz/volt for narrow and wideband FM input and 2 MHz/volt for the sweep input.

**11-11. Module Control.** Control information is latched in four bit control latches which are loaded by the processor through the RF control bus. The four bit RF ADD BUS 0-3 is decoded by the Address Decoder to determine which Control Latch the four bit RF DATA BUS 0-3 is to be stored. Synchronization of the data transfer is the function of the RF BUS EN line. Two decoded address outputs, RF LATCH 13 and 14, select latches on the receiver module for receiver control. One control latch output, LO/HI BAND SEL, goes to the RF Input module to control the frequency range of the output amplifier.

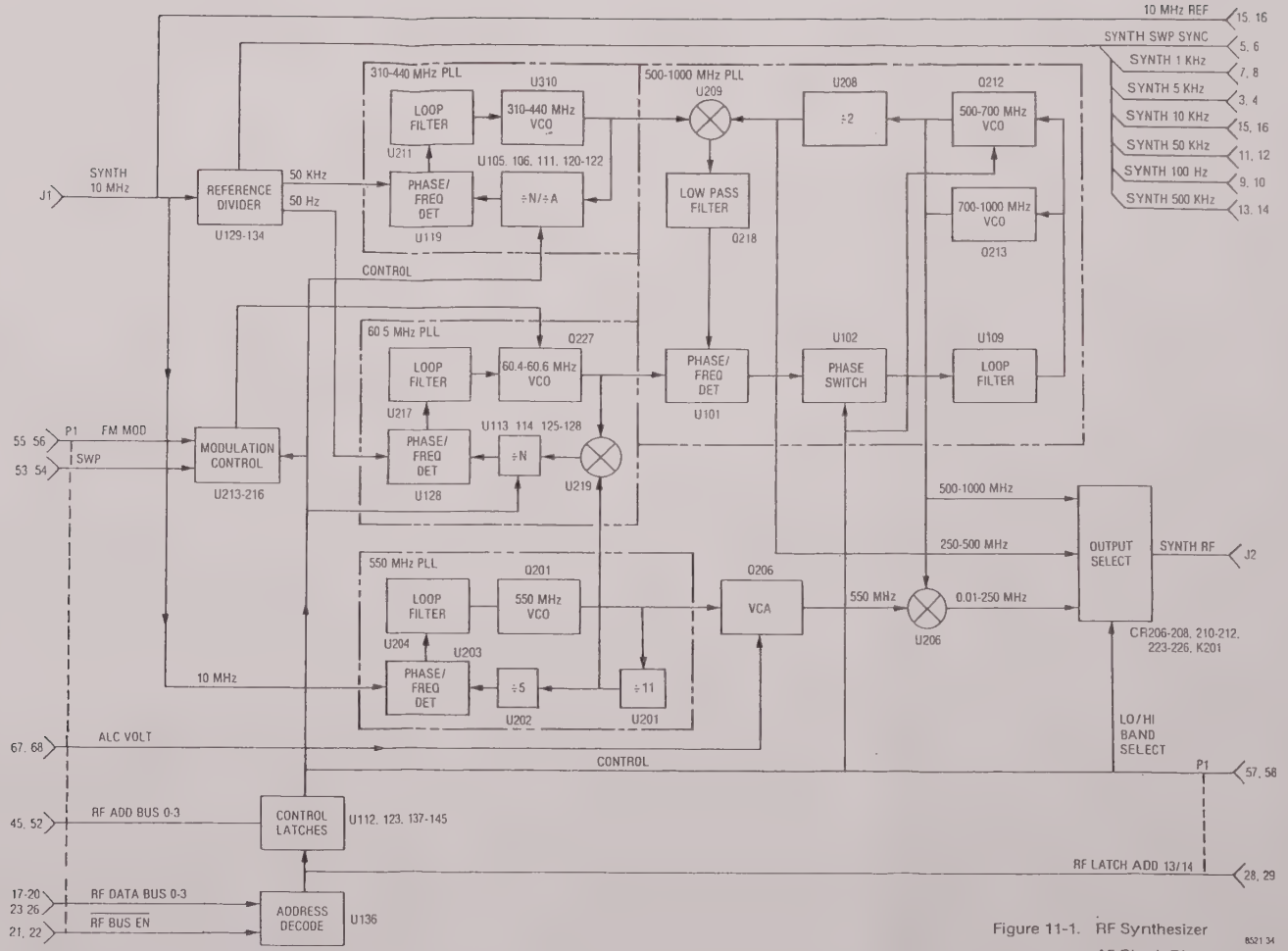



Figure 11-1. RF Synthesizer A5 Block Diagram

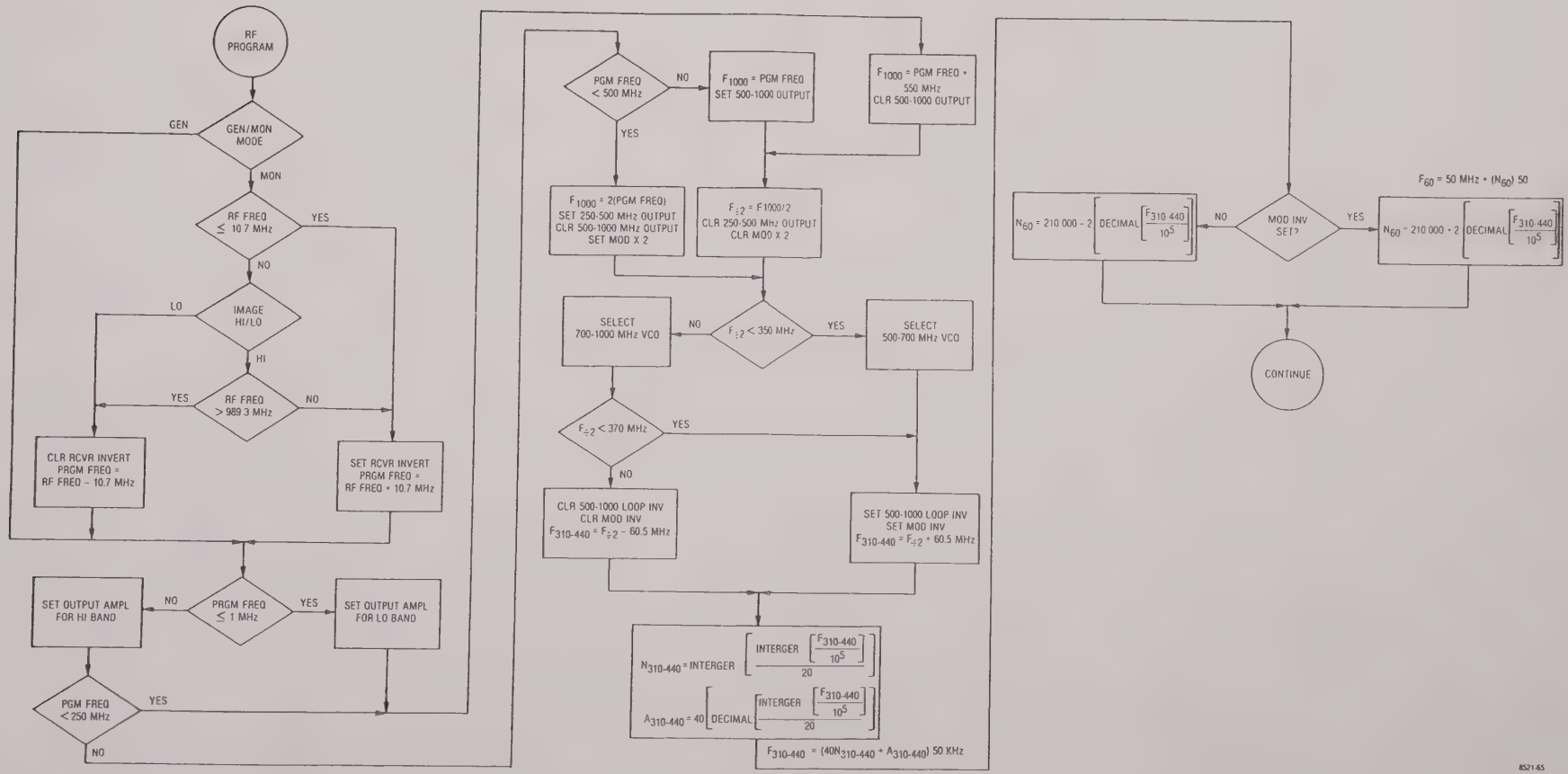

RF PROGRAM
GEN/MON MODE
GEN
MON
RF FREQ ≤ 10.7 MHz
YES
NO
IMAGE HI/LO
LO
HI
RF FREQ > 989.3 MHz
YES
NO
CLR RCVR INVERT PRGM FREQ = RF FREQ - 10.7 MHz
SET RCVR INVERT PRGM FREQ = RF FREQ + 10.7 MHz
SET OUTPUT AMPL FOR HI BAND
PRGM FREQ ≤ 1 MHz
NO
YES
SET OUTPUT AMPL FOR LO BAND
PGM FREQ < 250 MHz
YES
NO
PGM FREQ < 500 MHz
NO
YES
F1000 = PGM FREQ SET 500-1000 OUTPUT
F1000 = PGM FREQ + 550 MHz CLR 500-1000 OUTPUT
F1000 = 2(PGM FREQ) SET 250-500 MHz OUTPUT CLR 500-1000 MHz OUTPUT SET MOD X 2
F÷2 = F1000/2 CLR 250-500 MHz OUTPUT CLR MOD X 2
SELECT 700-1000 MHz VCO
NO
F÷2 < 350 MHz
YES
SELECT 500-700 MHz VCO
F÷2 < 370 MHz
YES
NO
CLR 500-1000 LOOP INV CLR MOD INV F310-440 = F÷2 - 60.5 MHz
SET 500-1000 LOOP INV SET MOD INV F310-440 = F÷2 + 60.5 MHz
N310-440 = INTERGER [ INTERGER [ F310-440 / 10^5 ] / 20 ]
A310-440 = 40 [ DECIMAL { INTERGER [ F310-440 / 10^5 ] / 20 } ]
F310-440 = {40N310-440 + A310-440} 50 KHz
N60 = 210 000 - 2 [ DECIMAL [ F310 440 / 10^5 ] ]
NO
MOD INV SET?
YES
F60 = 50 MHz + (N60) 50
N60 = 210 000 + 2 [ DECIMAL [ F310 440 / 10^5 ] ]
CONTINUE
8521-65

Figure 11-2. Frequency Programming Flow Diagram

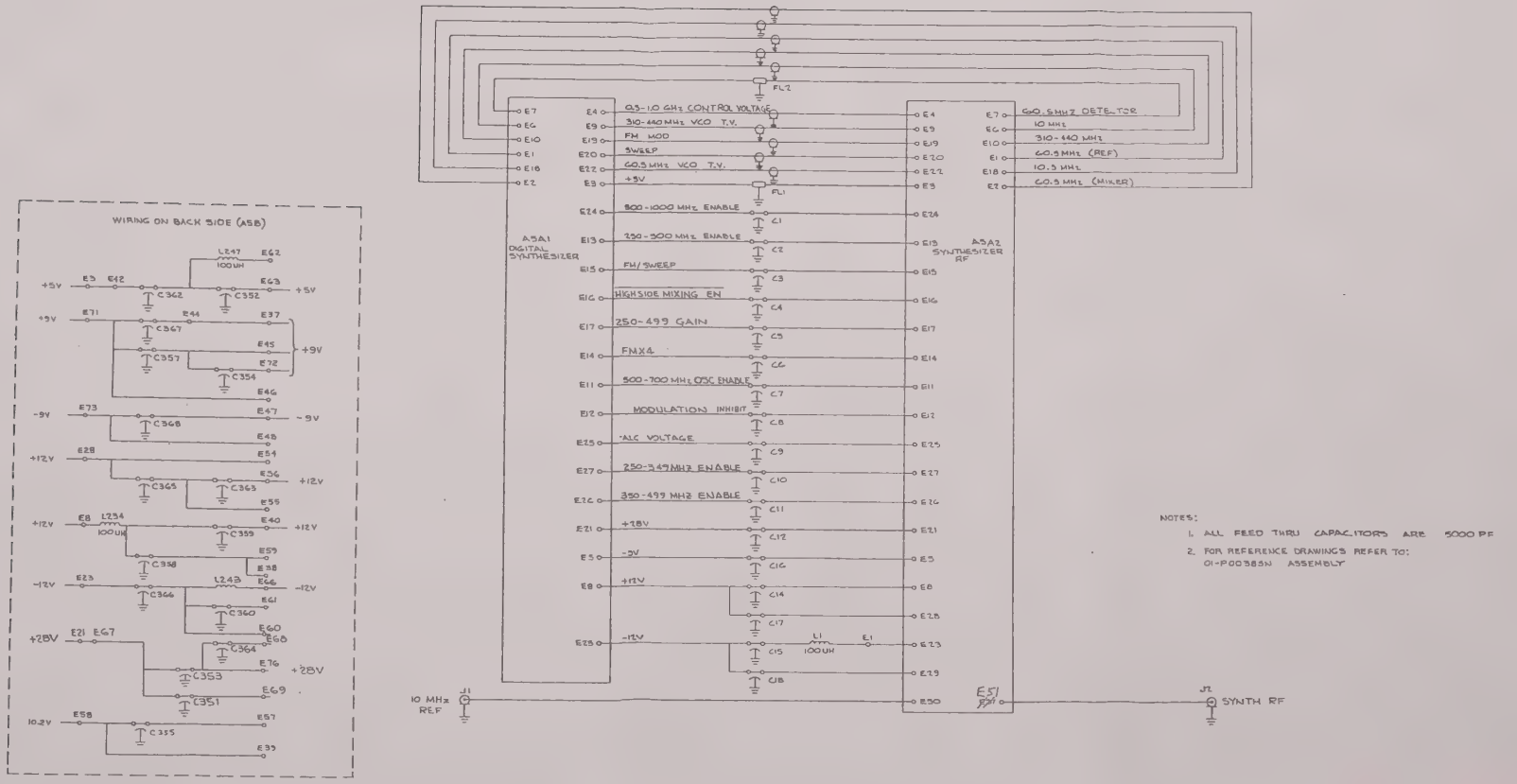



Figure 11-3. RF Synthesizer
A5 Schematic Diagram

| Find No. | Qty. Req. | Part No. | Nomenclature | Part Value |
|---|---|---|---|---|
| 001 | 1 | 84-80335A22 | PWB,DIGITAL SYNTHE | |
| 002 | AR | SN63WRP3 | SOLDER | |
| 003 | AR | 11-14167A01 | INK | BLACK |
| 004 | 1 | 03-139581 | SCREW,PH | 4-40X.312 |
| 005 | 2 | 04-7607 | WASHER,FLAT | 125 |
| 006 | 1 | 04-114583 | WASHER,LOCK | 112 |
| 007 | 1 | 02-7019 | NUT | .1120-40 |
| 009 | AR | | WIRE | #24 |
| 010 | AR | M23053/5-206-C | INSULATION SLEEVIN | .250 CLR |
| C 101 | 1 | 23-80396A35 | CAPACITOR | 30UF-10+75-15 |
| C 102 | 1 | 21-80396A51 | CAPACITOR | 1000PF-10-100 |
| C 103 | 1 | 21-80396A51 | CAPACITOR | 1000PF-10-100 |
| C 104 | 1 | 21-80396A51 | CAPACITOR | 1000PF-10-100 |
| C 105 | 1 | 21-80396A51 | CAPACITOR | 1000PF-10-100 |
| C 106 | 1 | 21D84494B46 | CAPACITOR | 180PF-5-500 |
| C 107 | 1 | 21C82372C10 | CAPACITOR | .05UF-20-25 |
| C 108 | 1 | 23-80396A40 | CAPACITOR | 10UF-25V |
| C 109 | 1 | 21-80396A52 | CAPACITOR | .01UF-20+80-200 |
| C 110 | 1 | 23-80396A36 | CAPACITOR | 10UF-20-35 |
| C 111 | 1 | 23D82397D50 | CAPACITOR | .22UF-20-35 |
| C 112 | 1 | 21-80396A52 | CAPACITOR | .01UF-20+80-200 |
| C 113 | 1 | 21-80396A52 | CAPACITOR | .01UF-20+80-200 |
| C 114 | 1 | 21-80396A52 | CAPACITOR | .01UF-20+80-200 |
| C 115 | 1 | 21D84494B37 | CAPACITOR | 11PF-5-500 |
| C 116 | 1 | 21D84494B37 | CAPACITOR | 11PF-5-500 |
| C 117 | 1 | 21D84494B24 | CAPACITOR | 39PF-5-500 |
| C 118 | 1 | 21D84494B24 | CAPACITOR | 39PF-5-500 |
| C 119 | 1 | 21D82428B10 | CAPACITOR | 3300PF-10-100 |
| C 120 | 1 | 21D82428B10 | CAPACITOR | 3300PF-10-100 |
| C 121 | 1 | 21-80396A52 | CAPACITOR | .01UF-20+80-200 |
| C 122 | 1 | 21-80369A82 | CAPACITOR | .1UF-20-100 |
| C 123 | 1 | 21D82187B07 | CAPACITOR | 470PF-10-500 |
| C 124 | 1 | 21-80369A82 | CAPACITOR | .1UF-20-100 |
| C 125 | 1 | 21-80396A51 | CAPACITOR | 1000PF-10-100 |
| C 126 | 1 | 21-80396A51 | CAPACITOR | 1000PF-10-100 |
| C 127 | 1 | 23D82397D04 | CAPACITOR | 15UF-20-15 |
| C 128 | 1 | 21-80370A02 | CAPACITOR | 2200PF-10-200 |
| C 129 | 1 | 23-80396A36 | CAPACITOR | 10UF-20-35 |
| C 130 | 1 | 21-80396A52 | CAPACITOR | .01UF-20-80-200 |
| C 131 | 1 | 21-80369A99 | CAPACITOR | .01UF-10-100 |
| C 132 | 1 | 21-80396A51 | CAPACITOR | 1000PF-10-100 |
| C 133 | 1 | 23-80396A40 | CAPACITOR | 10UF-25V |
| C 134 | 1 | 21-80396A51 | CAPACITOR | 1000PF-10-100 |
| C 135 | 1 | 21-80396A51 | CAPACITOR | 1000PF-10-100 |
| C 136 | 1 | 21-80396A51 | CAPACITOR | 1000PF-10-100 |
| C 137 | 1 | 21-80396A51 | CAPACITOR | 1000PF-10-100 |
| C 138 | 1 | 23-80396A40 | CAPACITOR | 10UF-25V |
| C 139 | 1 | 21-80396A51 | CAPACITOR | 1000PF-10-100 |
| C 140 | 1 | 23-80396A40 | CAPACITOR | 10UF-25V |
| C 141 | 1 | 21-80396A51 | CAPACITOR | 1000PF-10-100 |
| C 142 | 1 | 23-80396A36 | CAPACITOR | 10UF-20-35 |
| C 143 | 1 | 21D82187B04 | CAPACITOR | 270PF-10-500 |
| C 144 | 1 | 21-80370A18 | CAPACITOR | 33PF-5-100 |

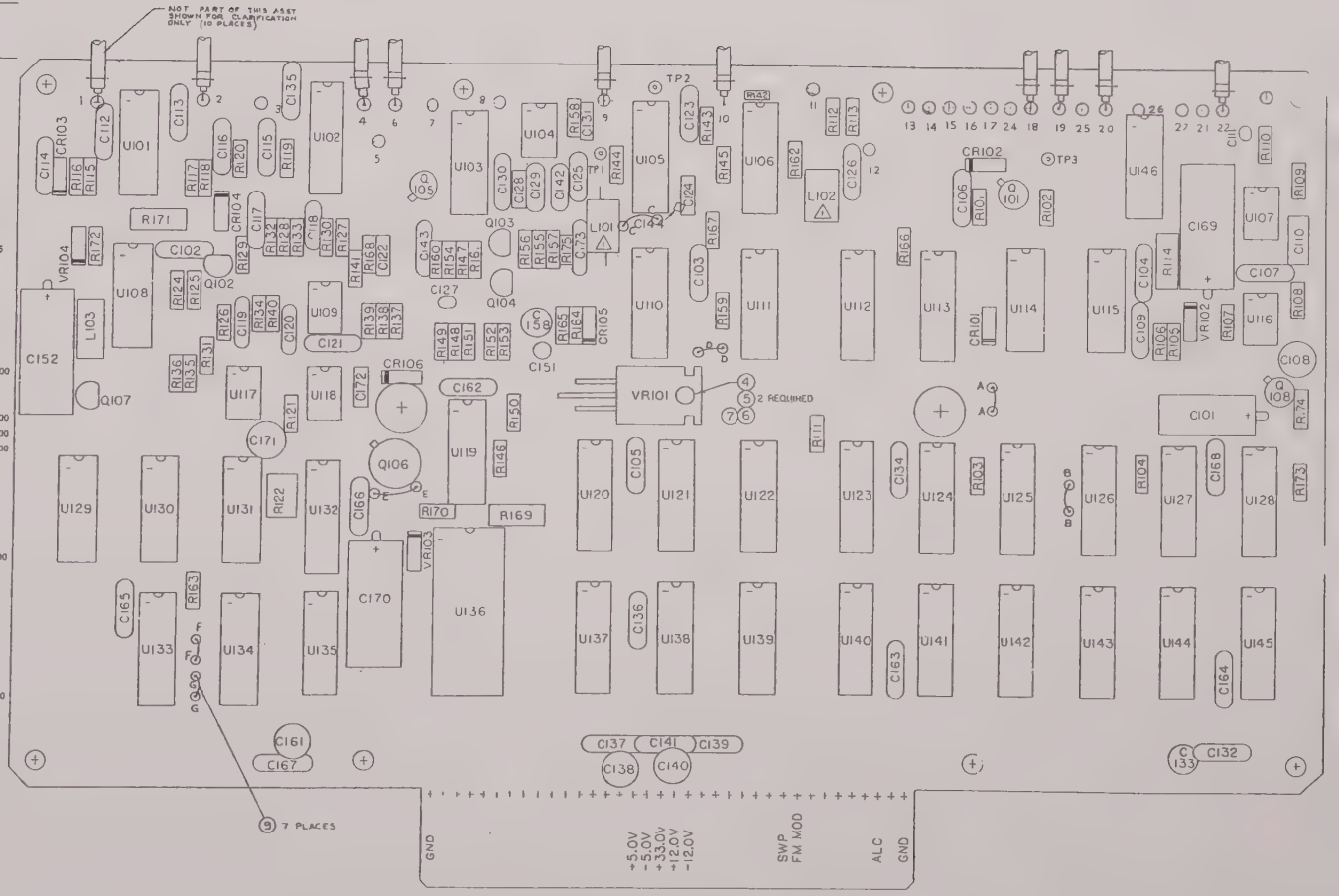



Figure 11-5. Digital Synthesizer A5A1 (RTC-4009B) Parts Location Diagram (Sheet 1 of 2)

| Find No. | Qty. Req. | Part No. | Nomenclature | Part Value |
|---|---|---|---|---|
| C 151 | 1 | 23D83441B15 | CAPACITOR | 1.0UF-20-35 |
| C 152 | 1 | 23-84665F10 | CAPACITOR | 100UF-25V |
| C 158 | 1 | 23-80396A40 | CAPACITOR | 10UF-25V |
| C 161 | 1 | 23-80396A40 | CAPACITOR | 10UF-25V |
| C 162 | 1 | 21-80396A51 | CAPACITOR | 1000PF-10-100 |
| C 163 | 1 | 21-80396A51 | CAPACITOR | 1000PF-10-100 |
| C 164 | 1 | 21-80396A51 | CAPACITOR | 1000PF-10-100 |
| C 165 | 1 | 21-80396A51 | CAPACITOR | 1000PF-10-100 |
| C 166 | 1 | 21-80396A51 | CAPACITOR | 1000PF-10-100 |
| C 167 | 1 | 21-80396A51 | CAPACITOR | 1000PF-10-100 |
| C 168 | 1 | 21-80396A51 | CAPACITOR | 1000PF-10-100 |
| C 169 | 1 | 23-84665F10 | CAPACITOR | 100UF-25V |
| C 170 | 1 | 23-84665F10 | CAPACITOR | 100UF-25V |
| C 171 | 1 | 23-80396A40 | CAPACITOR | 10UF-25V |
| C 172 | 1 | 21-80369A99 | CAPACITOR | .01UF-10-100 |
| C 173 | 1 | 21-80396A51 | CAPACITOR | 1000PF-10-100 |
| CR101 | 1 | 48D84616A01 | DIODE | |
| CR102 | 1 | 48-84463K02 | DIODE | |
| CR103 | 1 | 48-84463K02 | DIODE | |
| CR104 | 1 | 48-84463K02 | DIODE | |
| CR105 | 1 | 48-86850C47 | DIODE | |
| CR106 | 1 | 48-84463K02 | DIODE | |
| L 101 | 1 | 24-80369A46 | COIL | |
| L 102 | 1 | 24-80369A46 | COIL | |
| L 103 | 1 | 24-80370A39 | INDUCTOR | 12MH |
| Q 101 | 1 | 48-84308A92 | TRANSISTOR | |
| Q 102 | 1 | 48-80368A91 | TRANSISTOR | MPS6520 SCREENED |
| Q 103 | 1 | 48-80368A92 | TRANSISTOR | MPS6519 SCREENED |
| Q 104 | 1 | 48-80368A91 | TRANSISTOR | MPS6520 SCREENED |
| Q 105 | 1 | 48-84308A92 | TRANSISTOR | |
| Q 106 | 1 | 48-85851C32 | TRANSISTOR | |
| Q 107 | 1 | 48-80368A91 | TRANSISTOR | MPS6520 SCREENED |
| Q 108 | 1 | 48-2089C01 | TRANSISTOR | |
| R 101 | 1 | 6S124A73 | RESISTOR | 10K-5-1/4 |
| R 102 | 1 | 6S124A49 | RESISTOR | 1K-5-1/4 |
| R 103 | 1 | 6S124A73 | RESISTOR | 10K-5-1/4 |
| R 104 | 1 | 6S124A73 | RESISTOR | 10K-5-1/4 |
| R 105 | 1 | 6S124A73 | RESISTOR | 10K-5-1/4 |
| R 106 | 1 | 6S124A73 | RESISTOR | 10K-5-1/4 |
| R 107 | 1 | 6S124B16 | RESISTOR | 560K-5-1/4 |
| R 108 | 1 | 6S124A49 | RESISTOR | 1K-5-1/4 |
| R 109 | 1 | 6S124A53 | RESISTOR | 1.5K-5-1/4 |
| R 110 | 1 | 6S124A90 | RESISTOR | 51K-5-1/4 |
| R 111 | 1 | 6S124A56 | RESISTOR | 2.0K-5-1/4 |
| R 112 | 1 | 6S124A56 | RESISTOR | 2.0K-5-1/4 |
| R 113 | 1 | 6S124A56 | RESISTOR | 2.0K-5-1/4 |
| R 114 | 1 | 6S125A45 | RESISTOR | 680-5-1/2 |
| R 115 | 1 | 6S124A56 | RESISTOR | 2.0K-5-1/4 |
| R 116 | 1 | 6S124A41 | RESISTOR | 470-5-1/4 |
| R 117 | 1 | 6S124A56 | RESISTOR | 2.0K-5-1/4 |
| R 118 | 1 | 6S124A41 | RESISTOR | 470-5-1/4 |
| R 119 | 1 | 6S124A41 | RESISTOR | 470-5-1/4 |
| R 120 | 1 | 6S124A41 | RESISTOR | 470-5-1/4 |

| Find No. | Qty. Req. | Part No | Nomenclature | Part Value |
|---|---|---|---|---|
| R 121 | 1 | 6S124B19 | RESISTOR | 750K-5-1/4 |
| R 122 | 1 | 18D83452F19 | RESISTOR VARIABLE | 100K |
| R 124 | 1 | 6S124A49 | RESISTOR | 1K-5-1/4 |
| R 125 | 1 | 6S124A49 | RESISTOR | 1K-5-1/4 |
| R 126 | 1 | 6S124A49 | RESISTOR | 1K-5-1/4 |
| R 127 | 1 | 6S124A41 | RESISTOR | 470-5-1/4 |
| R 128 | 1 | 6S124A41 | RESISTOR | 470-5-1/4 |
| R 129 | 1 | 6S124A53 | RESISTOR | 1.5K-5-1/4 |
| R 130 | 1 | 6S124A53 | RESISTOR | 1.5K-5-1/4 |
| R 131 | 1 | 6S124A73 | RESISTOR | 10K-5-1/4 |
| R 132 | 1 | 6S124A53 | RESISTOR | 1.5K-5-1/4 |
| R 133 | 1 | 6S124A53 | RESISTOR | 1.5K-5-1/4 |
| R 134 | 1 | 6S124A39 | RESISTOR | 390-5-1/4 |
| R 135 | 1 | 6S124A56 | RESISTOR | 2.0K-5-1/4 |
| R 136 | 1 | 6S124A59 | RESISTOR | 2.7K-5-1/4 |
| R 137 | 1 | 6S124A25 | RESISTOR | 100-5-1/4 |
| R 138 | 1 | 6S124A61 | RESISTOR | 3.3K-5-1/4 |
| R 139 | 1 | 6S124A71 | RESISTOR | 8.2K-5-1/4 |
| R 140 | 1 | 6S124A39 | RESISTOR | 390-5-1/4 |
| R 141 | 1 | 6S124A49 | RESISTOR | 1K-5-1/4 |
| R 142 | 1 | 6S185A18 | RESISTOR | 51-5-1/8 |
| R 143 | 1 | 6S124A49 | RESISTOR | 1K-5-1/4 |
| R 144 | 1 | 6S124A41 | RESISTOR | 470-5-1/4 |
| R 145 | 1 | 6S124A41 | RESISTOR | 470-5-1/4 |
| R 146 | 1 | 6S124A51 | RESISTOR | 1.2K-5-1/4 |
| R 147 | 1 | 6S124A07 | RESISTOR | 18-5-1/4 |
| R 148 | 1 | 6S124A53 | RESISTOR | 1.5K-5-1/4 |
| R 149 | 1 | 6S124A35 | RESISTOR | 270-5-1/4 |
| R 150 | 1 | 6S124A41 | RESISTOR | 470-5-1/4 |
| R 151 | 1 | 6S124A41 | RESISTOR | 470-5-1/4 |
| R 152 | 1 | 6S124A57 | RESISTOR | 2.2K-5-1/4 |
| R 153 | 1 | 6S124A23 | RESISTOR | 82-5-1/4 |
| R 154 | 1 | 6S124A77 | RESISTOR | 15K-5-1/4 |
| R 155 | 1 | 6S124A77 | RESISTOR | 15K-5-1/4 |
| R 156 | 1 | 6S124A69 | RESISTOR | 6.8K-5-1/4 |
| R 157 | 1 | 6S124A49 | RESISTOR | 1K-5-1/4 |
| R 158 | 1 | 6S124A49 | RESISTOR | 1K-5-1/4 |
| R 159 | 1 | 6S124A49 | RESISTOR | 1K-5-1/4 |
| R 160 | 1 | 6S124A73 | RESISTOR | 10K-5-1/4 |
| R 161 | 1 | 6S124A49 | RESISTOR | 1K-5-1/4 |
| R 162 | 1 | 6S124A41 | RESISTOR | 470-5-1/4 |
| R 163 | 1 | 6S124A73 | RESISTOR | 10K-5-1/4 |
| R 164 | 1 | 6S124A65 | RESISTOR | 4.7K-5-1/4 |
| R 165 | 1 | 6S124A41 | RESISTOR | 470-5-1/4 |
| R 166 | 1 | 6S124A56 | RESISTOR | 2.0K-5-1/4 |
| R 167 | 1 | 6S124A41 | RESISTOR | 470-5-1/4 |
| R 168 | 1 | 6S124A41 | RESISTOR | 470-5-1/4 |
| R 169 | 1 | 6S125A13 | RESISTOR | 33-5-1/2 |
| R 170 | 1 | 6S124A47 | RESISTOR | 820-5-1/4 |
| R 171 | 1 | 6S125A43 | RESISTOR | 560-5-1/2 |
| R 172 | 1 | 6S124A63 | RESISTOR | 3.9K-5-1/4 |
| R 173 | 1 | 6S124A73 | RESISTOR | 10K-5-1/4 |
| R 174 | 1 | 6S124A27 | RESISTOR | 120-5-1/4 |

| Find No. | Qty. Req. | Part No. | Nomenclature | Part Value |
|---|---|---|---|---|
| R 175 | 1 | 6S185A49 | RESISTOR | 1000-5-1/8 |
| U 101 | 1 | 51-80321A69 | INTEGRATED CIRCUIT | MC12040L SCREENED |
| U 102 | 1 | 51-80368A79 | INTEGRATED CIRCUIT | MC10113L SCREENED |
| U 103 | 1 | 51-82884L48 | INTEGRATED CIRCUIT | MC14066BCP SCREENE |
| U 104 | 1 | 51-80345A04 | INTEGRATED CIRCUIT | CA3240E SCREENED |
| U 105 | 1 | 51-80345A15 | INTEGRATED CIRCUIT | MC12513L SCREENED |
| U 106 | 1 | 51-84561L55 | INTEGRATED CIRCUIT | MC10131L SCREENED |
| U 107 | 1 | 51-80345A01 | INTEGRATED CIRCUIT | CA3140E SCREENED |
| U 108 | 1 | 51-82884L48 | INTEGRATED CIRCUIT | MC14066BCP SCREENE |
| U 109 | 1 | 51-80345A01 | INTEGRATED CIRCUIT | CA3140E SCREENED |
| U 110 | 1 | 51-80368A59 | INTEGRATED CIRCUIT | MC12014L SCREENED |
| U 111 | 1 | 51-80368A74 | INTEGRATED CIRCUIT | SN74LS191N SCREENE |
| U 112 | 1 | 51-80368A58 | INTEGRATED CIRCUIT | MC14042B SCREENED |
| U 113 | 1 | 51-80368A59 | INTEGRATED CIRCUIT | MC12014L SCREENED |
| U 114 | 1 | 51-80368A18 | INTEGRATED CIRCUIT | SN74LS21NS SCREENE |
| U 115 | 1 | 51-82884L48 | INTEGRATED CIRCUIT | MC14066BCP SCREENE |
| U 116 | 1 | 51-80345A01 | INTEGRATED CIRCUIT | CA3140E SCREENED |
| U 117 | 1 | 51-80345A02 | INTEGRATED CIRCUIT | CA3160E SCREENED |
| U 118 | 1 | 51-80345A02 | INTEGRATED CIRCUIT | CA3160E SCREENED |
| U 119 | 1 | 51-84371K99 | INTEGRATED CIRCUIT | MC4044P SCREENED |
| U 120 | 1 | 51-80368A74 | INTEGRATED CIRCUIT | SN74LS191N SCREENE |
| U 121 | 1 | 51-80368A74 | INTEGRATED CIRCUIT | SN74LS191N SCREENE |
| U 122 | 1 | 51-80368A74 | INTEGRATED CIRCUIT | SN74LS191N SCREENE |
| U 123 | 1 | 51-80368A58 | INTEGRATED CIRCUIT | MC14042B SCREENED |
| U 124 | 1 | 51-80368A74 | INTEGRATED CIRCUIT | SN74LS191N SCREENE |
| U 125 | 1 | 51-80368A74 | INTEGRATED CIRCUIT | SN74LS191N SCREENE |
| U 126 | 1 | 51-80368A74 | INTEGRATED CIRCUIT | SN74LS191N SCREENE |
| U 127 | 1 | 51-80368A74 | INTEGRATED CIRCUIT | SN74LS191N SCREENE |
| U 128 | 1 | 51-83627M26 | INTEGRATED CIRCUIT | MC14568BCP SCREENE |
| U 129 | 1 | 51-82609M02 | INTEGRATED CIRCUIT | SN74LS73NS SCREENE |
| U 130 | 1 | 51-80368A11 | INTEGRATED CIRCUIT | SN74LS04NS SCREENE |
| U 131 | 1 | 51-82609M02 | INTEGRATED CIRCUIT | SN74LS73NS SCREENE |
| U 132 | 1 | 51-82609M68 | INTEGRATED CIRCUIT | SN74LS390NS |
| U 133 | 1 | 51-82609M68 | INTEGRATED CIRCUIT | SN74LS390NS |
| U 134 | 1 | 51-80368A50 | INTEGRATED CIRCUIT | MC14518BCP SCREENE |
| U 135 | 1 | 51-80368A11 | INTEGRATED CIRCUIT | SN74LS04NS SCREENE |
| U 136 | 1 | 51-80368A49 | INTEGRATED CIRCUIT | MC14514BCP SCREENE |
| U 137 | 1 | 51-80368A58 | INTEGRATED CIRCUIT | MC14042B SCREENED |
| U 138 | 1 | 51-80368A58 | INTEGRATED CIRCUIT | MC14042B SCREENED |
| U 139 | 1 | 51-80368A58 | INTEGRATED CIRCUIT | MC14042B SCREENED |
| U 140 | 1 | 51-80368A58 | INTEGRATED CIRCUIT | MC14042B SCREENED |
| U 141 | 1 | 51-80368A58 | INTEGRATED CIRCUIT | MC14042B SCREENED |
| U 142 | 1 | 51-80368A58 | INTEGRATED CIRCUIT | MC14042B SCREENED |
| U 143 | 1 | 51-80368A58 | INTEGRATED CIRCUIT | MC14042B SCREENED |
| U 144 | 1 | 51-80368A58 | INTEGRATED CIRCUIT | MC14042B SCREENED |
| U 145 | 1 | 51-80368A58 | INTEGRATED CIRCUIT | MC14042B SCREENED |
| U 146 | 1 | 51-80368A56 | INTEGRATED CIRCUIT | MC14001BCP SCREENE |
| VR101 | 1 | 51-80345A25 | INTEGRATED CIRCUIT | MC78M24CT |
| VR102 | 1 | 48-83193A59 | DIODE,ZENNER | 5.6V-5-.4 |
| VR103 | 1 | 48-83193A59 | DIODE,ZENNER | 5.6V-5-.4 |
| VR104 | 1 | 48-82256C50 | DIODE,ZENER | 3.0-5-.4 |

Figure 11-5. Digital Synthesizer A5A1 (RTC-4009B) Parts Location Diagram (Sheet 2 of 2)

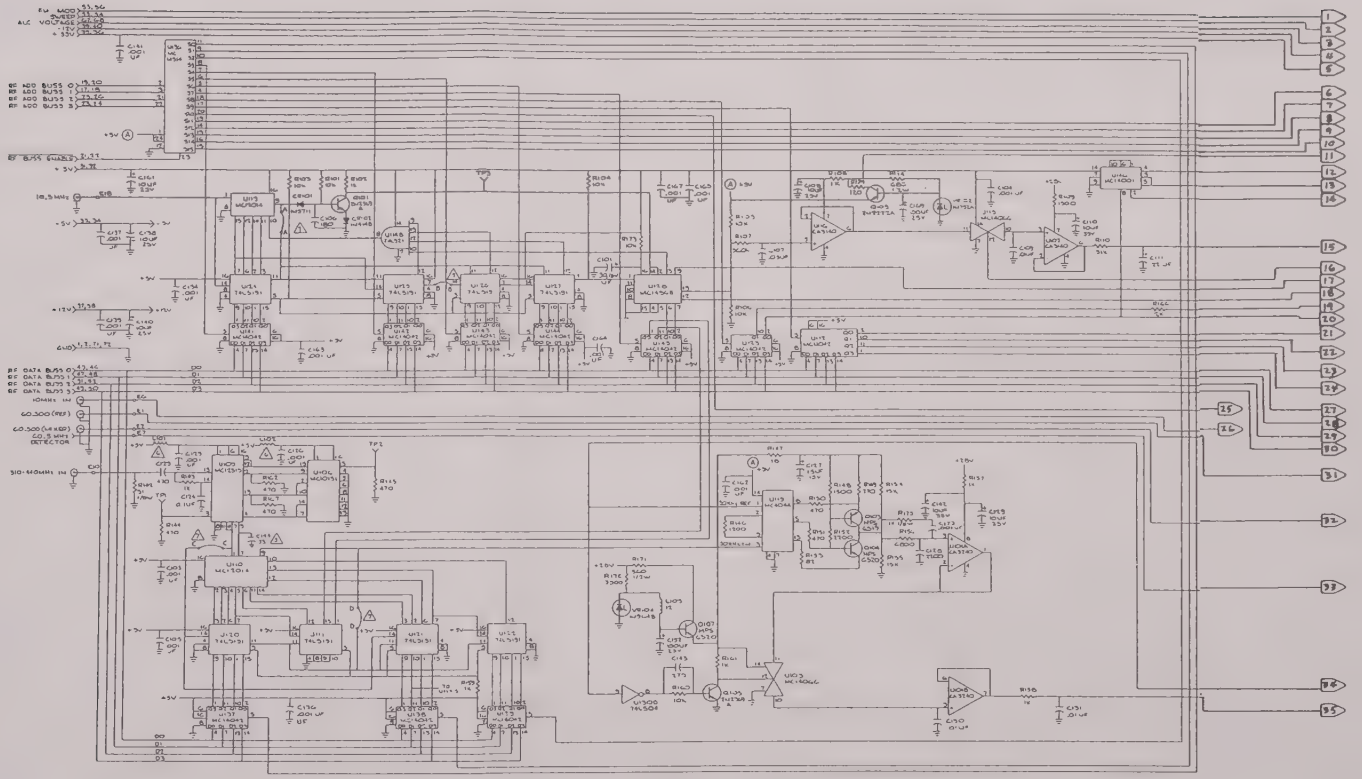


Figure 11-4. Digital Synthesizer A5A1
Schematic Diagram (Sheet 1 of 2)

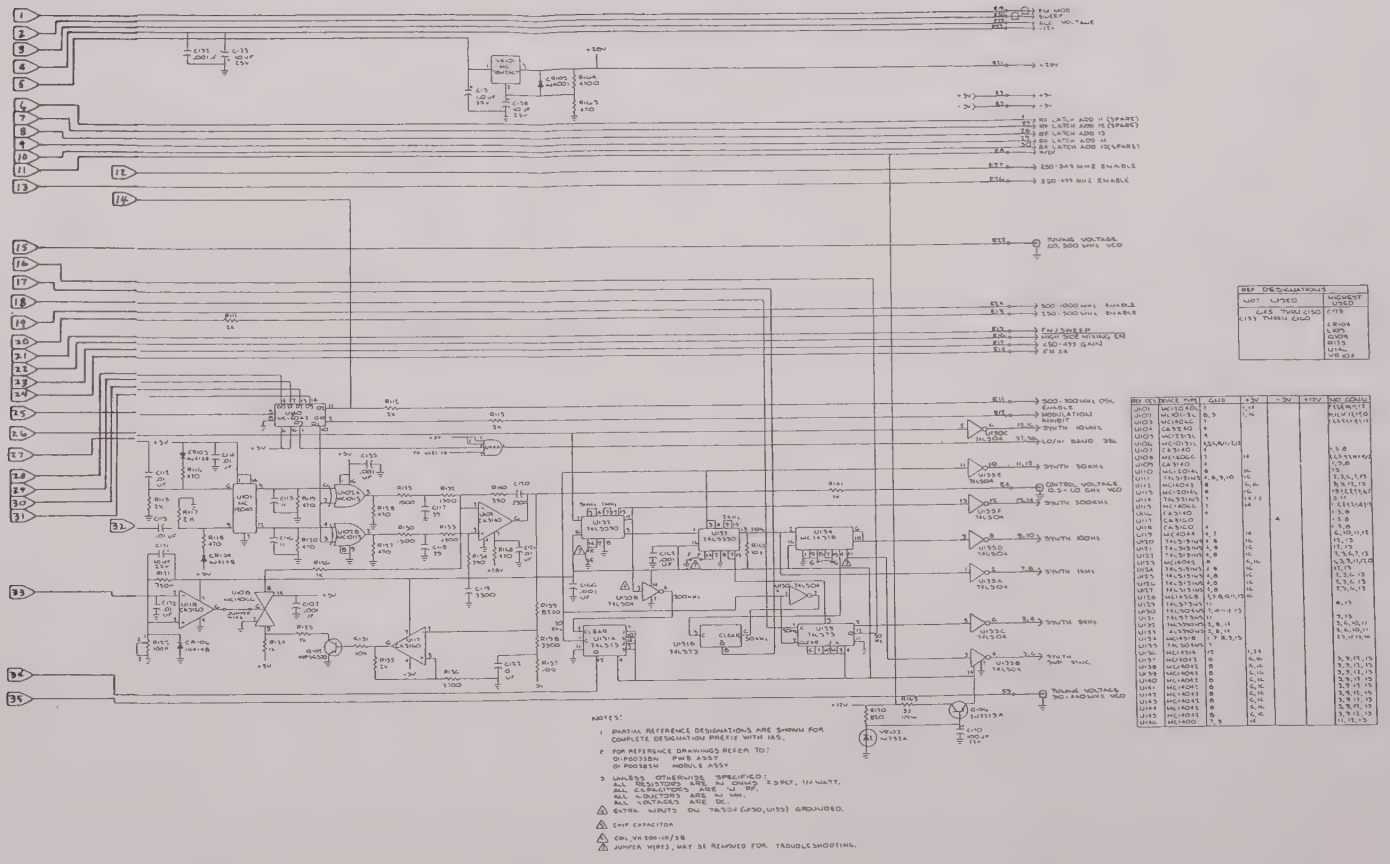
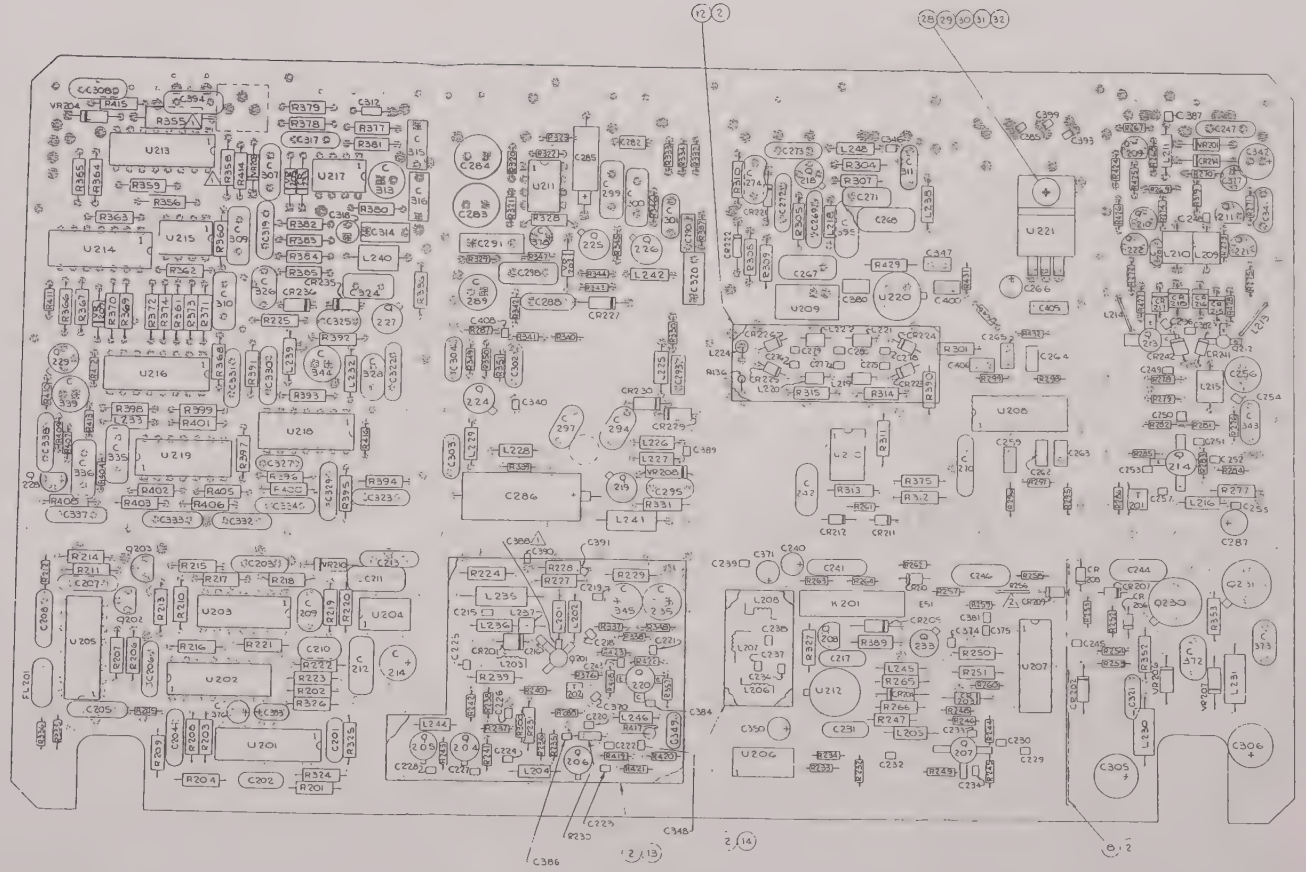


Figure 11-4. Digital Synthesizer A5A1, Schematic Diagram (Sheet 2 of 2)

Figure 11-7. RF Synthesizer A5A2 (RTC-4010B)
Parts Location Diagram



NOTES:
1. VALUE OF COMPONENT TO BE SELECT IN TEST
2. R256 IS SELECT IN TEST WITH NOMINAL VALUE OF "24 GA BUS WIRE

Figure 11-7. RF Synthesizer A5A2 (RTC-4010B) Parts Location Diagram

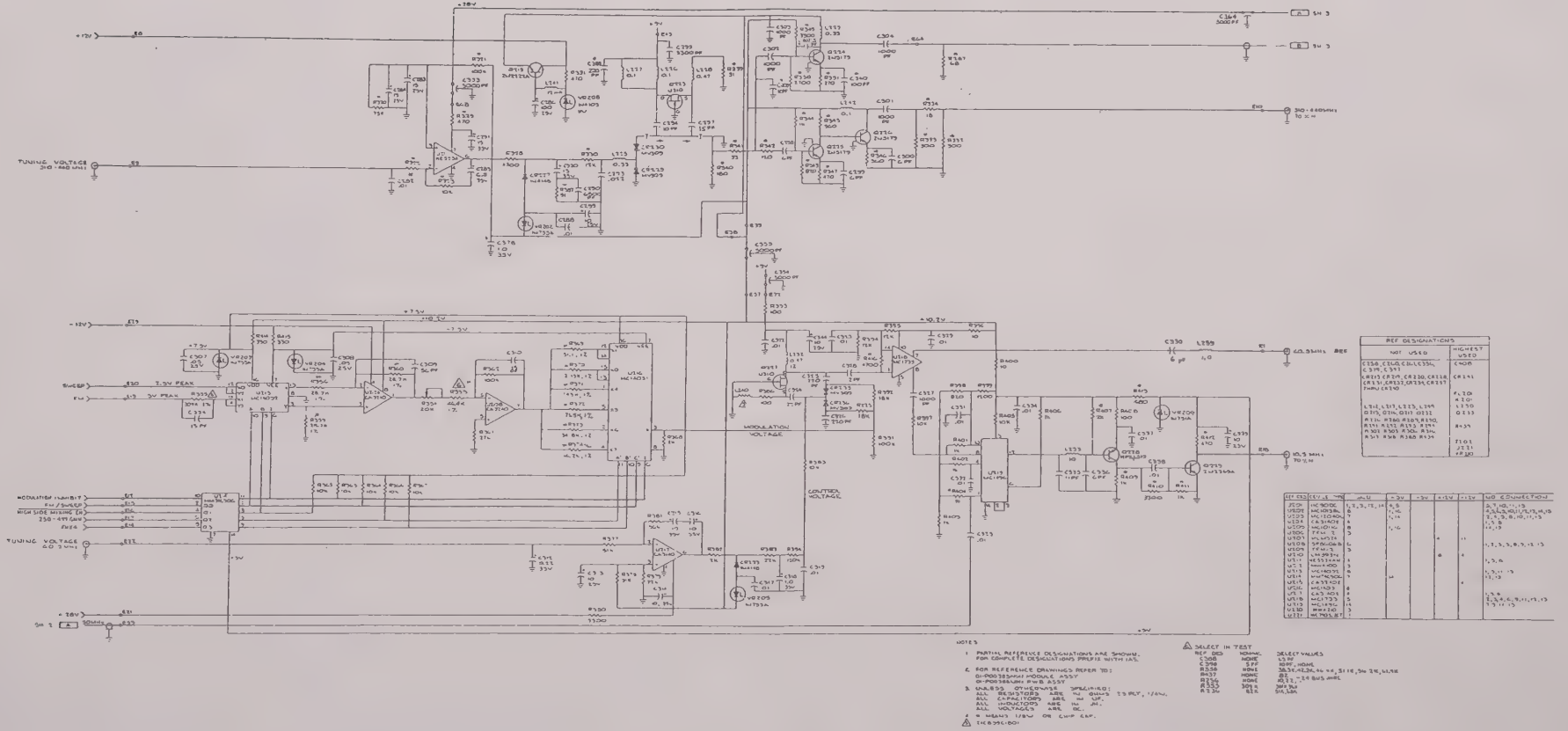


Figure 11-6. RF Synthesizer A5A2
Schematic Diagram (Sheet 1 of 3)

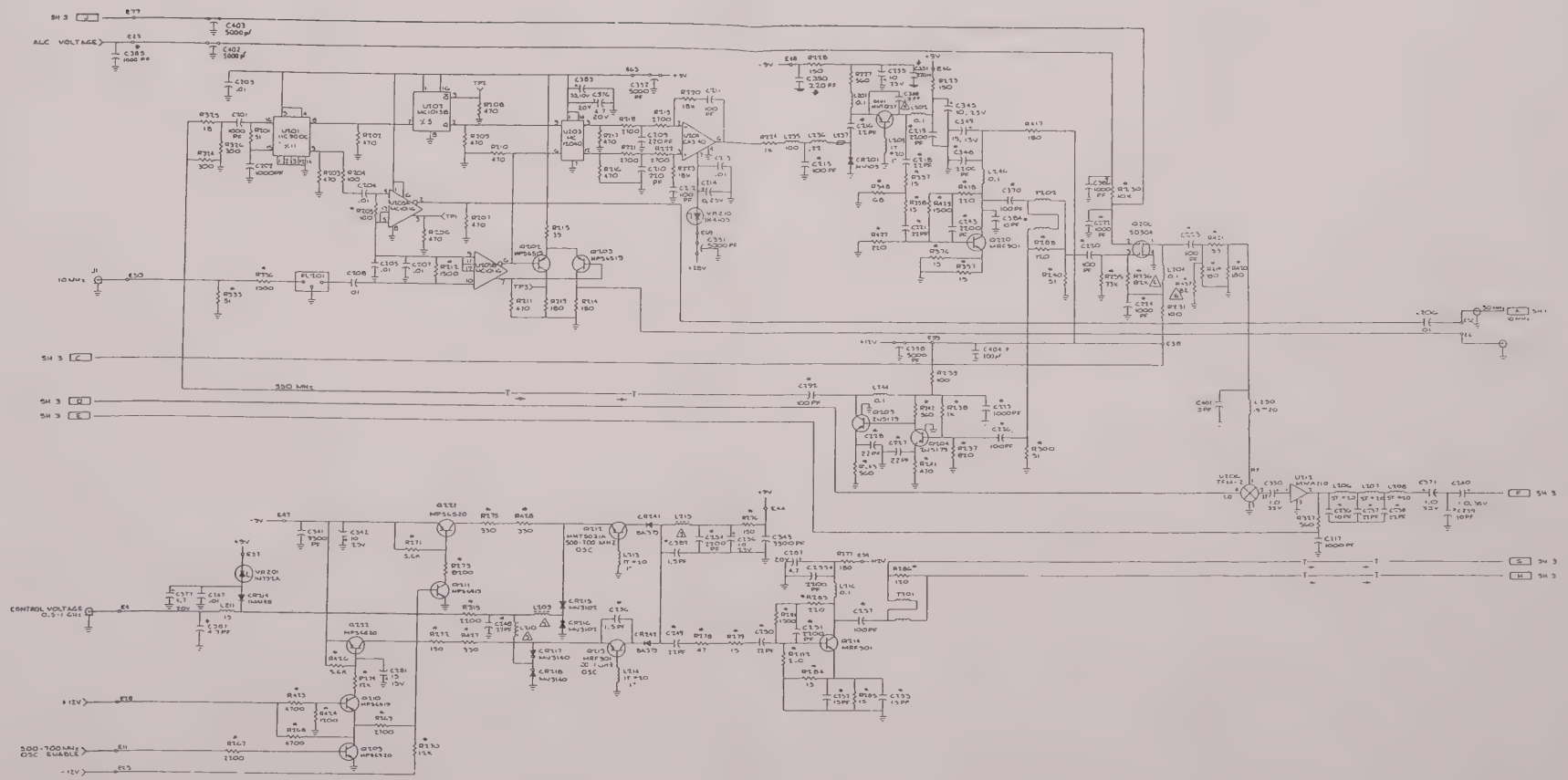


Figure 11-6. RF Synthesizer A5A2
Schematic Diagram (Sheet 2 of 3)

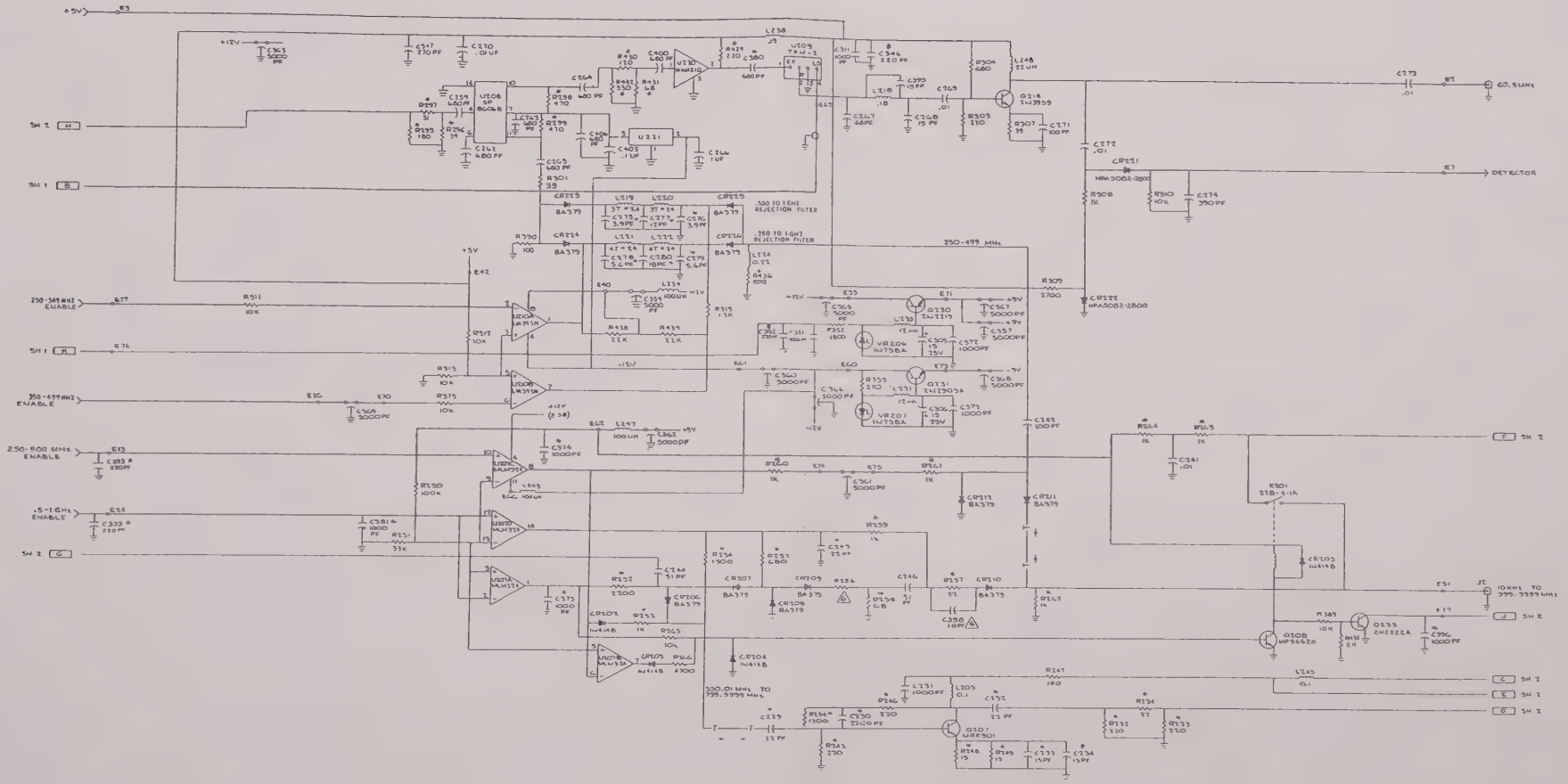


Figure 11-6. RF Synthesizer A5A2
Schematic Diagram (Sheet 3 of 3)

| Find No. | Qty. Req. | Part No. | Nomenclature | Part Value |
|---|---|---|---|---|
| | | RTC-1001B | SYNTHESIZER | |
| 001 | 1 | 27-80396A87 | CHASSIS,SYNTHESIZE | |
| 002 | 1 | 15-80335A37 | COVER,DIGITAL SYNT | |
| 003 | 4 | 5C84500B03 | EYELET | |
| 004 | 4 | 42C84284B01 | RETAINER | |
| 005 | 28 | 03-138804 | SCREW,MACH,SEMS PH | .112-40X.312 |
| 006 | AR | | WIRE | #24 WHT |
| 008 | AR | SN63WRMAP3 | SOLDER | |
| 009 | AR | 11-14167A01 | INK | BLACK |
| 010 | 1 | 15-80335A36 | COVER,RF SYNTHESIZ | |
| 011 | 1 | 26-80370A67 | SHIELD,CAPACITOR | |
| 012 | 1 | 64-80370A68 | PLATE,CONNECTOR | |
| 013 | 4 | 03-139581 | SCREW,PH | 4-40X.312 |
| 014 | 38 | 04-114583 | WASHER,LOCK | .112 |
| 015 | 19 | 43-P07955V001 | STANDOFF,MALE-FEMA | |
| 016 | AR | 30-84421F13 | CABLE,RF | WHT |
| 017 | 19 | 03-136785 | SCREW,PH | .112-40X.250 |
| 018 | AR | 30-15068A34 | CABLE,RF | WHITE |
| 019 | AR | 30-15068A29 | CABLE | WHITE |
| 020 | 7 | 03-139012 | SCREW,MACH,SEMS PH | .112-40X.250 |
| 021 | 1 | 29-14070A91 | TERMINAL | |
| 022 | AR | | WIRE | #24 |
| 023 | AR | M23053/5-104-9 | INSULATION SLEEVIN | .125 WHT |
| 024 | AR | M23053/5-103-9 | INSULATION SLEEVIN | .093 WHT |
| 025 | 17 | 10-P07994V001 | SOLDER RING,PREFOR | |
| 026 | 2 | 10-P07994V002 | SOLDER RING,PREFOR | |
| A 001 | 1 | RTC-4009B | DIGITAL SYNTH ASSY | |
| A 002 | 1 | RTC-4010B | RF SYNTHESIZER ASS | |
| C 001 | 1 | 2404-603-Y5V0502Z | CAPACITOR | 5000PF-20+80-500 |
| C 002 | 1 | 2404-603-Y5V0502Z | CAPACITOR | 5000PF-20+80-500 |
| C 003 | 1 | 2404-603-Y5V0502Z | CAPACITOR | 5000PF-20+80-500 |
| C 004 | 1 | 2404-603-Y5V0502Z | CAPACITOR | 5000PF-20+80-500 |
| C 005 | 1 | 2404-603-Y5V0502Z | CAPACITOR | 5000PF-20+80-500 |
| C 006 | 1 | 2404-603-Y5V0502Z | CAPACITOR | 5000PF-20+80-500 |
| C 007 | 1 | 2404-603-Y5V0502Z | CAPACITOR | 5000PF-20+80-500 |
| C 008 | 1 | 2404-603-Y5V0502Z | CAPACITOR | 5000PF-20+80-500 |
| C 009 | 1 | 2404-603-Y5V0502Z | CAPACITOR | 5000PF-20+80-500 |
| C 010 | 1 | 2404-603-Y5V0502Z | CAPACITOR | 5000PF-20+80-500 |
| C 011 | 1 | 2404-603-Y5V0502Z | CAPACITOR | 5000PF-20+80-500 |
| C 012 | 1 | 2404-603-Y5V0502Z | CAPACITOR | 5000PF-20+80-500 |
| C 014 | 1 | 2404-603-Y5V0502Z | CAPACITOR | 5000PF-20+80-500 |
| C 015 | 1 | 2404-603-Y5V0502Z | CAPACITOR | 5000PF-20+80-500 |
| C 016 | 1 | 2404-603-Y5V0502Z | CAPACITOR | 5000PF-20+80-500 |
| C 017 | 1 | 2404-603-Y5V0502Z | CAPACITOR | 5000PF-20+80-500 |
| C 018 | 1 | 2404-603-Y5V0502Z | CAPACITOR | 5000PF-20+80-500 |
| FL001 | 1 | 91-80346A11 | FILTER,RF | 1250-003 |
| FL002 | 1 | 91-80346A11 | FILTER,RF | 1250-003 |
| J 001 | 1 | 5658-5007-10 | CONNECTOR,RF | |
| J 002 | 1 | 09-80331A79 | CONNECTOR,RF | |
| L 001 | 1 | 24-80369A37 | COIL | 100UH |

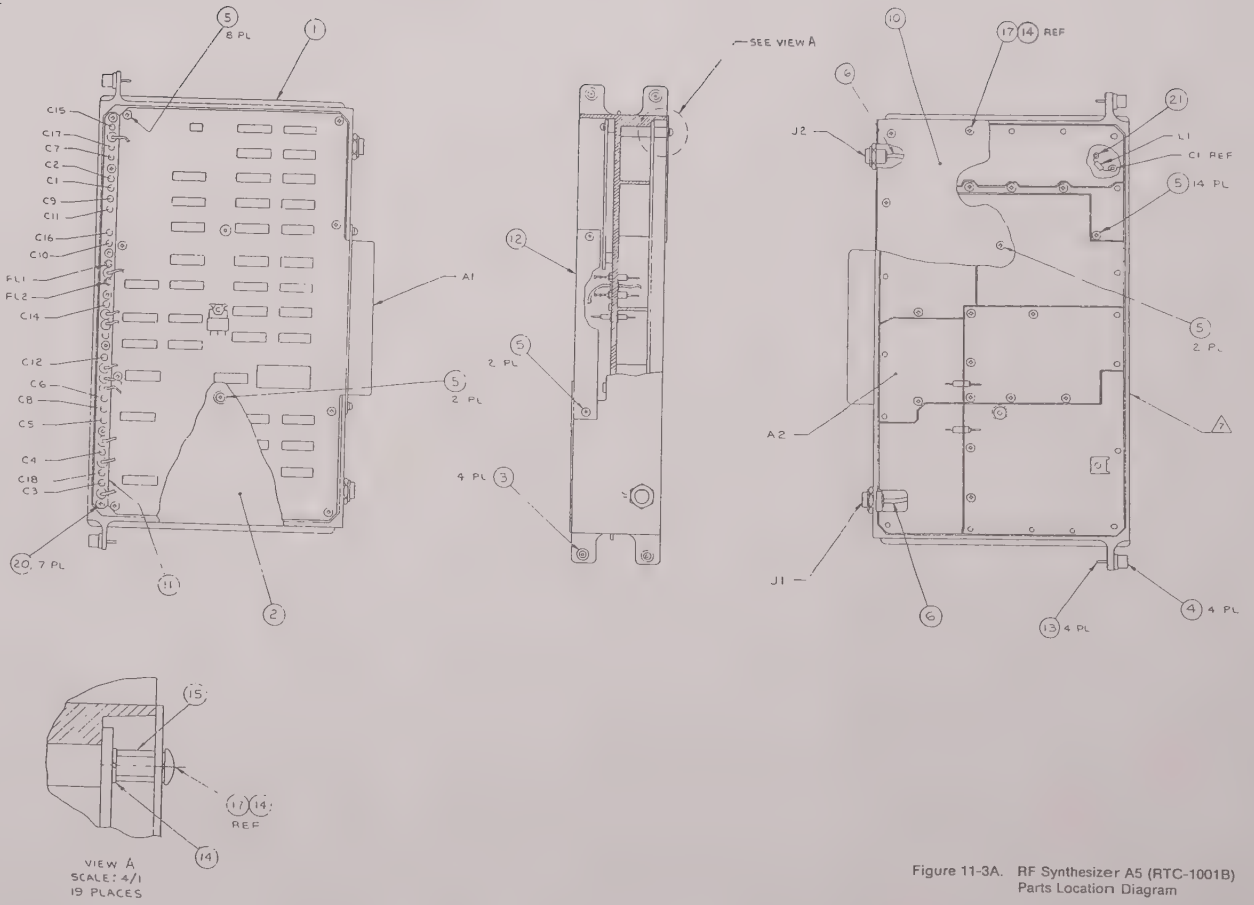



Figure 11-3A. RF Synthesizer A5 (RTC-1001B) Parts Location Diagram

| Find No. | Qty. Req. | Part No. | Nomenclature | Part Value |
|---|---|---|---|---|
| | | RTC-4010B | .RF SYNTHESIZER | |
| 001 | 1 | 84-P08109V001 | PWB-RF SYNTHESIZER | |
| 002 | AR | SN63WRMAP3 | SOLDER | |
| 003 | AR | 11-14167A01 | INK | BLACK |
| 004 | 1 | 26-80370A58 | SHIELD | |
| 005 | 1 | 26-80370A59 | SHIELD | |
| 006 | 1 | 26-80370A60 | SHIELD | |
| 007 | 1 | 26-80370A61 | SHIELD | |
| 008 | 1 | 26-80370A62 | SHIELD | |
| 009 | 1 | 26-80370A63 | SHIELD | |
| 011 | AR | 01-80305A61 | CABLE,SEMI-RIGID | |
| 012 | 1 | 26-80370A64 | SHIELD | |
| 013 | 1 | 26-80370A66 | SHIELD,FILTER | |
| 014 | 1 | 26-80370A65 | SHIELD | |
| 015 | AR | SN63WRP3 | SOLDER | |
| 016 | AR | M23053/5-103-9 | INSULATION SLEEVIN | .093 WHT |
| 017 | AR | M23053/5-205-C | INSULATION SLEEVIN | .187 CLR |
| 018 | AR | | INSULATION SLEEVIN | #22 WHT |
| 019 | AR | | INSULATION TAPE | 1IN YELLOW |
| 020 | AR | | WIRE | #24 |
| 021 | AR | RTV3145 | ADHESIVE | |
| 022 | AR | | WIRE,TEFLON | #22 SOLID WHT |
| 023 | AR | | INSULATING SLEEVIN | #14 WHT |
| 024 | AR | SN62WRMAP3 | SOLDER | |
| 025 | 23 | 303-250 | MOUNT,COMPONENT | |
| 026 | AR | | WIRE | #24 WHT |
| 027 | 20 | 10-P07994V001 | SOLDER RING,PREFOR | |
| 028 | 1 | MS51957-14 | SCREW,PH | .1120-40X.312 |
| 029 | 1 | B51547F015 | BUSHING,NYLON INSU | |
| 030 | 1 | NAS620C4L | WASHER,FLAT,LT | .112 |
| 031 | 1 | MS35338-135 | WASHER,LOCK | .112 |
| 032 | 1 | NAS671C4 | NUT,HEX,LT | .1120-40 |
| C 201 | 1 | 21-80396A51 | CAPACITOR | 1000PF-10-100 |
| C 202 | 1 | 21-80396A51 | CAPACITOR | 1000PF-10-100 |
| C 203 | 1 | 21-80396A52 | CAPACITOR | .01UF-20+80-200 |
| C 204 | 1 | 21-80396A52 | CAPACITOR | .01UF-20+80-200 |
| C 205 | 1 | 21-80396A52 | CAPACITOR | .01UF-20+80-200 |
| C 206 | 1 | 21-80396A52 | CAPACITOR | .01UF-20+80-200 |
| C 207 | 1 | 21-80396A52 | CAPACITOR | .01UF-20+80-200 |
| C 208 | 1 | 21-80396A52 | CAPACITOR | .01UF-20+80-200 |
| C 209 | 1 | 21D82187B08 | CAPACITOR | 220PF-10-500 |
| C 210 | 1 | 21D82187B08 | CAPACITOR | 220PF-10-500 |
| C 211 | 1 | 21D84494B04 | CAPACITOR | 100PF-5-500 |
| C 212 | 1 | 21D84494B04 | CAPACITOR | 100PF-5-500 |
| C 213 | 1 | 21-80396A52 | CAPACITOR | .01UF-20 - 80-20 |
| C 214 | 1 | 23-80396A40 | CAPACITOR | 10UF-25V |
| C 215 | 1 | 21-80370A21 | CAPACITOR | 100PF-20-100 |
| C 216 | 1 | 21-80370A14 | CAPACITOR | 22PF-5-100 |
| C 217 | 1 | 21-80396A51 | CAPACITOR | 1000PF-10-100 |
| C 218 | 1 | 21-80370A14 | CAPACITOR | 22PF-5-100 |
| C 219 | 1 | 21-80370A24 | CAPACITOR | 2200PF-20-100 |
| C 220 | 1 | 21-80370A21 | CAPACITOR | 100PF-20-100 |
| C 221 | 1 | 21-80370A14 | CAPACITOR | 22PF-5-100 |
| C 222 | 1 | 21-80370A22 | CAPACITOR | 1000PF-20-100 |
| C 223 | 1 | 21-80370A21 | CAPACITOR | 100PF-20-100 |
| C 224 | 1 | 21-80370A22 | CAPACITOR | 1000PF-20-100 |
| C 225 | 1 | 21-80370A22 | CAPACITOR | 1000PF-20-100 |
| C 226 | 1 | 21-80370A21 | CAPACITOR | 100PF-20-100 |
| C 227 | 1 | 21-80370A14 | CAPACITOR | 22PF-5-100 |
| C 228 | 1 | 21-80370A14 | CAPACITOR | 22PF-5-100 |
| C 229 | 1 | 21-80370A14 | CAPACITOR | 22PF-5-100 |
| C 230 | 1 | 21-80370A24 | CAPACITOR | 2200PF-20-100 |
| C 231 | 1 | 21-80396A51 | CAPACITOR | 1000PF-10-100 |
| C 232 | 1 | 21-80370A14 | CAPACITOR | 22PF-5-100 |
| C 233 | 1 | 21-80370A12 | CAPACITOR | 15PF-5-100 |
| C 234 | 1 | 21-80370A12 | CAPACITOR | 15PF-5-100 |
| C 235 | 1 | 23-80396A40 | CAPACITOR | 10UF-25V |
| C 236 | 1 | 21-80370A10 | CAPACITOR | 10PF-5-100 |
| C 237 | 1 | 21-80370A14 | CAPACITOR | 22PF-5-100 |
| C 238 | 1 | 21-80370A14 | CAPACITOR | 22PF-5-100 |
| C 239 | 1 | 21-80370A10 | CAPACITOR | 10PF-5-100 |
| C 240 | 1 | 23D83441B15 | CAPACITOR | 1.0UF-20-35 |
| C 241 | 1 | 21-80396A52 | CAPACITOR | .01UF-20+80-200 |
| C 242 | 1 | 21D84494B04 | CAPACITOR | 100PF-5-500 |
| C 243 | 1 | 21-80370A24 | CAPACITOR | 2200PF-20-100 |
| C 244 | 1 | 21D84494B01 | CAPACITOR | 51PF-5-500 |
| C 245 | 1 | 21-80370A14 | CAPACITOR | 22PF-5-100 |
| C 246 | 1 | 21D84494B01 | CAPACITOR | 51PF-5-500 |
| C 247 | 1 | 21-80396A52 | CAPACITOR | .01UF-20+80-200 |
| C 248 | 1 | 21-80370A16 | CAPACITOR | 27PF-5-100 |
| C 249 | 1 | 21-80370A14 | CAPACITOR | 22PF-5-100 |
| C 250 | 1 | 21-80370A14 | CAPACITOR | 22PF-5-100 |
| C 251 | 1 | 21-80370A24 | CAPACITOR | 2200PF-20-100 |
| C 252 | 1 | 21-80370A12 | CAPACITOR | 15PF-5-100 |
| C 253 | 1 | 21-80370A12 | CAPACITOR | 15PF-5-100 |
| C 254 | 1 | 21-80370A24 | CAPACITOR | 2200PF-20-100 |
| C 255 | 1 | 21-80370A24 | CAPACITOR | 2200PF-20-100 |
| C 256 | 1 | 23-80396A40 | CAPACITOR | 10UF-25V |
| C 257 | 1 | 21-80370A21 | CAPACITOR | 100PF-20-100 |
| C 259 | 1 | 21-80370A29 | CAPACITOR | 680PF-20-50 |
| C 262 | 1 | 21-80370A29 | CAPACITOR | 680PF-20-50 |
| C 263 | 1 | 21-80370A29 | CAPACITOR | 680PF-20-50 |
| C 264 | 1 | 21-80370A29 | CAPACITOR | 680PF-20-50 |
| C 265 | 1 | 21-80370A29 | CAPACITOR | 680PF-20-50 |
| C 266 | 1 | 23D83441B15 | CAPACITOR | 1.0UF-20-35 |
| C 267 | 1 | 21D84494B34 | CAPACITOR | 68PF-5-500 |
| C 268 | 1 | 21D84494B38 | CAPACITOR | 15PF-5-500 |
| C 269 | 1 | 21-80396A52 | CAPACITOR | .01UF-20+80-200 |
| C 270 | 1 | 21-80396A52 | CAPACITOR | .01UF-20+80-200 |
| C 271 | 1 | 21-850118 | CAPACITOR | 100PF-5-500 |
| C 272 | 1 | 21-80396A52 | CAPACITOR | .01UF-20+80-200 |
| C 273 | 1 | 21-80396A52 | CAPACITOR | .01UF-20+80-200 |
| C 274 | 1 | 21D865922 | CAPACITOR | 390PF-10-500 |
| C 275 | 1 | 21-80370A17 | CAPACITOR | 3.9PF-.25-100 |
| C 276 | 1 | 21-80370A17 | CAPACITOR | 3.9PF-.25-100 |
| C 277 | 1 | 21-80370A11 | CAPACITOR | 12PF-5-100 |
| C 278 | 1 | 21-80370A20 | CAPACITOR | 5.6PF-.25-100 |
| C 279 | 1 | 21-80370A20 | CAPACITOR | 5.6PF-.25-100 |
| C 280 | 1 | 21-80370A13 | CAPACITOR | 18PF-5-100 |
| C 281 | 1 | 23D82397D04 | CAPACITOR | 15UF-20-15 |
| C 282 | 1 | 21-80369A99 | CAPACITOR | .01UF-10-100 |
| C 283 | 1 | 23-80396A41 | CAPACITOR | 15UF-25V |
| C 284 | 1 | 23-80396A41 | CAPACITOR | 15UF-25V |
| C 285 | 1 | 23-80369A54 | CAPACITOR | 6.8UF-10-35 |
| C 286 | 1 | 23-84665F10 | CAPACITOR | 100UF-25V |
| C 287 | 1 | 23D83441B18 | CAPACITOR | 4.7UF-20-20 |
| C 288 | 1 | 21-80396A52 | CAPACITOR | .01UF-20-80-200 |
| C 289 | 1 | 23-80396A40 | CAPACITOR | 10UF-25V |
| C 290 | 1 | 21-80370A03 | CAPACITOR | 680PF-10-100 |
| C 291 | 1 | 23-80396A37 | CAPACITOR | 15UF-20-35 |
| C 292 | 1 | 21-80370A21 | CAPACITOR | 100PF-20-100 |
| C 293 | 1 | 21-80370A04 | CAPACITOR | .022UF-10-100 |
| C 294 | 1 | 21-859934 | CAPACITOR | 10PF-5-500 |
| C 295 | 1 | 21D82428B10 | CAPACITOR | 3300PF-10-100 |
| C 296 | 1 | 21-80370A09 | CAPACITOR | 1.5PF-.5PF-100 |
| C 297 | 1 | 21-859936 | CAPACITOR | 15PF-5-500 |
| C 298 | 1 | 21D84494B74 | CAPACITOR | 6PF-.5PF-500 |
| C 299 | 1 | 21D84494B74 | CAPACITOR | 6PF-.5PF-500 |
| C 300 | 1 | 21D84494B74 | CAPACITOR | 6PF-.5PF-500 |
| C 301 | 1 | 21-80396A51 | CAPACITOR | 1000PF-10-100 |
| C 302 | 1 | 21-80396A51 | CAPACITOR | 1000PF-10-100 |
| C 303 | 1 | 21-80396A51 | CAPACITOR | 1000PF-10-100 |
| C 304 | 1 | 21-80396A51 | CAPACITOR | 1000PF-10-100 |
| C 305 | 1 | 23-80396A41 | CAPACITOR | 15UF-25V |
| C 306 | 1 | 23-80396A41 | CAPACITOR | 15UF-25V |
| C 307 | 1 | 21C82372C10 | CAPACITOR | .05UF-20-25 |
| C 308 | 1 | 21C82372C10 | CAPACITOR | .05UF-20-25 |
| C 309 | 1 | 21D84494B45 | CAPACITOR | 56PF-5-500 |
| C 310 | 1 | 21D84494B38 | CAPACITOR | 15PF-5-500 |
| C 311 | 1 | 21-80396A51 | CAPACITOR | 1000PF-10-100 |
| C 312 | 1 | 23D82397D50 | CAPACITOR | .22UF-20-3 |
| C 313 | 1 | 23-80396A40 | CAPACITOR | 10UF-25V |
| C 314 | 1 | 23-80396A36 | CAPACITOR | 10UF-20-35 |
| C 315 | 1 | 23-80396A36 | CAPACITOR | 10UF-20-35 |
| C 316 | 1 | 23-80396A36 | CAPACITOR | 10UF-20-35 |
| C 317 | 1 | 21-80396A52 | CAPACITOR | .01UF-20+80-200 |
| C 318 | 1 | 23D83441B15 | CAPACITOR | 1.0UF-20-35 |
| C 319 | 1 | 21-80396A52 | CAPACITOR | .01UF-20+80-200 |
| C 320 | 1 | 23-80396A37 | CAPACITOR | 15UF-20-35 |
| C 321 | 1 | 21-80396A51 | CAPACITOR | 1000PF-10-100 |
| C 322 | 1 | 21-80396A52 | CAPACITOR | .01UF-20+80-200 |
| C 323 | 1 | 21-80396A52 | CAPACITOR | .01UF-20+80-200 |
| C 324 | 1 | 21-80369A88 | CAPACITOR | 22PF-5-500 |
| C 325 | 1 | 21D82187B08 | CAPACITOR | 220PF-10-500 |
| C 326 | 1 | 21D82187B08 | CAPACITOR | 220PF-10-500 |
| C 327 | 1 | 21-80396A51 | CAPACITOR | 1000PF-10-100 |
| C 328 | 1 | 21-14032G97 | CAPACITOR | 2PF-.5PF-500 |
| C 329 | 1 | 21-80396A52 | CAPACITOR | .01UF-20+80-200 |
| C 330 | 1 | 21D84494B74 | CAPACITOR | 6PF-5-500 |
| C 331 | 1 | 21-80396A52 | CAPACITOR | .01UF-20+80-200 |
| C 332 | 1 | 21-80396A52 | CAPACITOR | .01UF-20+80-200 |
| C 333 | 1 | 21-80396A52 | CAPACITOR | .01UF-20+80-200 |
| C 334 | 1 | 21-80396A52 | CAPACITOR | .01UF-20+80-200 |
| C 335 | 1 | 21D84494B37 | CAPACITOR | 11PF-5-500 |
| C 336 | 1 | 21D84494B74 | CAPACITOR | 6PF-.5PF-500 |
| C 337 | 1 | 21-80396A52 | CAPACITOR | .01UF-20+80-200 |
| C 338 | 1 | 21-80396A52 | CAPACITOR | .01UF-20+80-200 |
| C 339 | 1 | 23-80396A40 | CAPACITOR | 10UF-25V |
| C 340 | 1 | 21-80370A21 | CAPACITOR | 100PF-20-100 |
| C 341 | 1 | 21D82428B10 | CAPACITOR | 3300PF-10-100 |
| C 342 | 1 | 23-80396A40 | CAPACITOR | 10UF-25V |
| C 343 | 1 | 21D82428B10 | CAPACITOR | 3300PF-10- |
| C 344 | 1 | 23-80396A40 | CAPACITOR | 10UF-25V |
| C 345 | 1 | 23-80396A40 | CAPACITOR | 10UF-25V |
| C 346 | 1 | 21-80370A23 | CAPACITOR | 220PF-20-100 |
| C 347 | 1 | 21-80370A27 | CAPACITOR | 270PF-20-50 |
| C 348 | 1 | 21-80370A24 | CAPACITOR | 2200PF-20-100 |
| C 349 | 1 | 23D82397D04 | CAPACITOR | 15UF-20-15 |
| C 350 | 1 | 23D83441B15 | CAPACITOR | 1.0UF-20-35 |
| C 351 | 1 | 2404-603-Y5V0502Z | CAPACITOR | 5000PF-20+80-500 |
| C 352 | 1 | 2404-603-Y5V0502Z | CAPACITOR | 5000PF-20+80-500 |
| C 353 | 1 | 2404-603-Y5V0502Z | CAPACITOR | 5000PF-20+80-500 |
| C 354 | 1 | 2404-603-Y5V0502Z | CAPACITOR | 5000PF-20+80-500 |
| C 355 | 1 | 2404-603-Y5V0502Z | CAPACITOR | 5000PF-20+80-500 |
| C 357 | 1 | 2404-603-Y5V0502Z | CAPACITOR | 5000PF-20+80-500 |
| C 358 | 1 | 2404-603-Y5V0502Z | CAPACITOR | 5000PF-20+80-500 |
| C 359 | 1 | 2404-603-Y5V0502Z | CAPACITOR | 5000PF-20+80-500 |
| C 360 | 1 | 2404-603-Y5V0502Z | CAPACITOR | 5000PF-20+80-500 |
| C 361 | 1 | 2404-603-Y5V0502Z | CAPACITOR | 5000PF-20+80-500 |
| C 362 | 1 | 2404-603-Y5V0502Z | CAPACITOR | 5000PF-20+80-500 |
| C 363 | 1 | 2404-603-Y5V0502Z | CAPACITOR | 5000PF-20+80-500 |
| C 364 | 1 | 2404-603-Y5V0502Z | CAPACITOR | 5000PF-20+80-500 |
| C 365 | 1 | 2404-603-Y5V0502Z | CAPACITOR | 5000PF-20+80-500 |
| C 366 | 1 | 2404-603-Y5V0502Z | CAPACITOR | 5000PF-20+80-500 |
| C 367 | 1 | 2404-603-Y5V0502Z | CAPACITOR | 5000PF-20+80-500 |
| C 368 | 1 | 2404-603-Y5V0502Z | CAPACITOR | 5000PF-20+80-500 |
| C 369 | 1 | 2404-603-Y5V0502Z | CAPACITOR | 5000PF-20+80-500 |

Figure 11-7. RF Synthesizer A5A2 (RTC-4010B) Parts Location Diagram

| Find No. | Qty. Req. | Part No. | Nomenclature | Part Value |
|---|---|---|---|---|
| C 370 | 1 | 21-80370A21 | CAPACITOR | 100PF-20-100 |
| C 371 | 1 | 23D83441B15 | CAPACITOR | 1 0UF-20-35 |
| C 372 | 1 | 21-80396A51 | CAPACITOR | 1000PF-10-100 |
| C 373 | 1 | 21-80396A51 | CAPACITOR | 1000PF-10-100 |
| C 374 | 1 | 21-80370A22 | CAPACITOR | 1000PF-20-100 |
| C 375 | 1 | 21-80370A22 | CAPACITOR | 1000PF-20-100 |
| C 376 | 1 | 23D83441B18 | CAPACITOR | 4 7UF-20-20 |
| C 377 | 1 | 23D83441B18 | CAPACITOR | 4 7UF-20-20 |
| C 378 | 1 | 23D83441B15 | CAPACITOR | 1 0UF-20-35 |
| C 380 | 1 | 21-80370A29 | CAPACITOR | 680PF-20-50 |
| C 381 | 1 | 21-80370A22 | CAPACITOR | 1000PF-20-100 |
| C 382 | 1 | 21-80370A09 | CAPACITOR | 1 5PF- 5PF-100 |
| C 383 | 1 | 23D82397D18 | CAPACITOR | 33UF-20-10 |
| C 384 | 1 | 21-80370A10 | CAPACITOR | 10PF-5-100 |
| C 385 | 1 | 21 80370A22 | CAPACITOR | 1000PF-20-100 |
| C 386 | 1 | 21-80370A22 | CAPACITOR | 1000PF-20-100 |
| C 387 | 1 | 21-80370A19 | CAPACITOR | 4 7PF- 5PF-100 |
| C 388 | S01 | 21 80370A09 | CAPACITOR | 1 5PF- 5PF-100 |
| C 389 | 1 | 21 80370A25 | CAPACITOR | 220PF-5-50 |
| C 390 | 1 | 21-80370A23 | CAPACITOR | 220PF-20-100 |
| C 391 | 1 | 21-80370A23 | CAPACITOR | 220PF-20-100 |
| C 392 | 1 | 21-80370A23 | CAPACITOR | 220PF-20-100 |
| C 393 | 1 | 21-80370A23 | CAPACITOR | 220PF-20-100 |
| C 394 | 1 | 21D84494B38 | CAPACITOR | 15PF-5 500 |
| C 395 | 1 | 21D84494B38 | CAPACITOR | 15PF-5-500 |
| C 396 | 1 | 21-80370A22 | CAPACITOR | 1000PF-20-100 |
| C 398 | SAR | 21-859934 | CAPACITOR | 10PF-5-500 |
| C 398 | 1 | 21-80369A85 | CAPACITOR | 5PF- 5PF-500 |
| C 399 | 1 | 21-80370A23 | CAPACITOR | 220PF-20-100 |
| C 400 | 1 | 21-80370A29 | CAPACITOR | 680PF-20-50 |
| C 401 | 1 | 21-871966 | CAPACITOR | 5PF- 5PF-500 |
| C 402 | 1 | 2404-603-Y5V0502Z | CAPACITOR | 5000PF-20 + 80-500 |
| C 403 | 1 | 2404-603-Y5V0502Z | CAPACITOR | 5000PF-20 + 80-500 |
| C 404 | 1 | 21-80370A21 | CAPACITOR | 100PF-20-100 |
| C 405 | 1 | 21 80369A82 | CAPACITOR | .1UF-20-100 |
| C 406 | 1 | 21 80370A29 | CAPACITOR | 680PF-20-50 |
| C 407 | 1 | 21-80370A09 | CAPACITOR | 1 5PF- 5PF-100 |
| C 408 | 1 | 21-80370A10 | CAPACITOR | 10PF-5-100 |
| CR201 | 1 | 48-80396A96 | DIODE VARACTOR | MV309 SCREENED |
| CR202 | 1 | 48-84463K02 | DIODE | |
| CR203 | 1 | 48-84463K02 | DIODE | |
| CR204 | 1 | 48-84463K02 | DIODE | |
| CR205 | 1 | 48-84463K02 | DIODE | |
| CR206 | 1 | 48-80345A62 | DIODE | |
| CR207 | 1 | 48-80345A62 | DIODE | |
| CR208 | 1 | 48-80345A62 | DIODE | |
| CR209 | 1 | 48-80345A62 | DIODE | |
| CR210 | 1 | 48-80345A62 | DIODE | |
| CR211 | 1 | 48 80345A62 | DIODE | |
| CR212 | 1 | 48-80345A62 | DIODE | |
| CR214 | 1 | 48-84463K02 | DIODE | |
| CR215 | 1 | 48-82190H47 | VARACTOR | |
| CR216 | 1 | 48-82190H47 | VARACTOR | |
| CR217 | 1 | 48-82190H37 | DIODE | |
| CR218 | 1 | 48-82190H37 | DIODE | |
| CR221 | 1 | 48D84616A01 | DIODE | |
| CR222 | 1 | 48D84616A01 | DIODE | |
| CR223 | 1 | 48-80345A62 | DIODE | |
| CR224 | 1 | 48-80345A62 | DIODE | |
| CR225 | 1 | 48 80345A62 | DIODE | |
| CR226 | 1 | 48 80345A62 | DIODE | |
| CR227 | 1 | 48-84463K02 | DIODE | |
| CR229 | 1 | 48-80396A96 | DIODE,VARACTOR | MV309 SCREENED |
| CR230 | 1 | 48-80396A96 | DIODE VARACTOR | MV309 SCREENED |
| CR233 | 1 | 48-84463K02 | DIODE | |
| CR235 | 1 | 48 80396A96 | DIODE,VARACTOR | MV309 SCREENED |
| CR236 | 1 | 48-80396A96 | DIODE,VARACTOR | MV309 SCREENED |
| CR241 | 1 | 48 80345A62 | DIODE | |
| CR242 | 1 | 48 80345A62 | DIODE | |

| Find No. | Qty. Req | Part No. | Nomenclature | Part Value |
|---|---|---|---|---|
| FL201 | 1 | 48-80346A08 | CRYSTAL FILTER | 10MHZ-2 POLE |
| K 201 | 1 | 80-80346A02 | RELAY | |
| L 201 | 1 | 24-80369A19 | COIL | 1UH |
| L 202 | 1 | 24-80369A19 | COIL | 1UH |
| L 203 | 1 | 24-80369A50 | COIL,AIR WOUND | 1T #20 |
| L 204 | 1 | 24-80369A19 | COIL | 1UH |
| L 205 | 1 | 24-80369A19 | COIL | 1UH |
| L 206 | 1 | 24-80369A49 | COIL,AIR WOUND | 5 #20 |
| L 207 | 1 | 24-80369A49 | COIL,AIR WOUND | 5 |
| L 208 | 1 | 24-80369A49 | COIL,AIR WOUND | 5 #20 |
| L 209 | 1 | 24C83961B01 | CHOKE,RF | |
| L 210 | 1 | 24C83961B01 | CHOKE RF | |
| L 211 | 1 | 24-80369A23 | COIL | 15UH |
| L 213 | 1 | 24-80369A50 | COIL,AIR WOUND | 1T #20 |
| L 214 | 1 | 24-80369A50 | COIL,AIR WOUND | 1T #20 |
| L 215 | 1 | C 24C83961B01 | F R | |
| L 216 | 1 | 24-80369A19 | COIL | 1UH |
| L 218 | 1 | 24-80369A24 | COILH | 18UH |
| L 219 | 1 | 24-80369A48 | COIL,AIR WOUND | 3T #24 |
| L 220 | 1 | 24-80369A48 | COIL,AIR WOUND | 3T #24 |
| L 221 | 1 | 24-80369A51 | COIL,AIR WOUND | 4T #24 |
| L 222 | 1 | 24-80369A51 | COIL,AIR WOUND | 4T #24 |
| L 224 | 1 | 24-80369A25 | COIL | 22UH |
| L 225 | 1 | 24-80369A26 | COIL | 33UH |
| L 226 | 1 | 24-80369A19 | COIL | 1UH |
| L 227 | 1 | 24-80369A19 | COIL | 1UH |
| L 228 | 1 | 24-80369A27 | COIL | 47UH |
| L 229 | 1 | 24-80369A26 | COIL | 33UH |
| L 230 | 1 | 24-80370A39 | INDUCTOR | 12MH |
| L 231 | 1 | 24-80370A39 | INDUCTOR | 12MH |
| L 232 | 1 | 24-80369A14 | COIL | 47UH |
| L 233 | 1 | 24-80369A29 | COIL | 10UH |
| L 234 | 1 | 24-80369A37 | COIL | 100UH |
| L 235 | 1 | 24-80369A37 | COIL | 100UH |
| L 236 | 1 | 24-80369A25 | COIL | 22UH |
| L 237 | 1 | 76-83960B01 | FERRITE BEAD | |
| L 238 | 1 | 24-80369A23 | COIL | 15UH |
| L 239 | 1 | 24-80369A22 | COIL | 1UH |
| L 240 | 1 | 24C83961B01 | CHOKE,RF | |
| L 241 | 1 | 24-80370A39 | INDUCTOR | 12MH |
| L 242 | 1 | 24-80369A19 | COIL | 1UH |
| L 243 | 1 | 24-80369A37 | COIL | 100UH |
| L 244 | 1 | 24-80369A19 | COIL | 1UH |
| L 245 | 1 | 24-80369A19 | COIL | 1UH |
| L 246 | 1 | 24-80369A19 | COIL | 1UH |
| L 247 | 1 | 24-80369A37 | COIL | 100UH |
| L 248 | 1 | 24-80369A31 | COIL | 22UH |
| L 250 | 1 | 24-80369A52 | COIL AIR WOUND | |
| Q 201 | 1 | 48-80345A45 | TRANSISTOR | |
| Q 202 | 1 | 48-80368A92 | TRANSISTOR | MPS6519 SCREENED |
| Q 203 | 1 | 48-80368A92 | TRANSISTOR | MPS6519 SCREENED |
| Q 204 | 1 | 48-84309A61 | TRANSISTOR | |
| Q 205 | 1 | 48-84309A61 | TRANSISTOR | |
| Q 206 | 1 | 48-80345A54 | TRANSISTOR | |
| Q 207 | 1 | 48R00869870 | TRANSISTOR | |
| Q 208 | 1 | 48-80368A91 | TRANSISTOR | MPS6520 SCREENED |
| Q 209 | 1 | 48-80368A91 | TRANSISTOR | MPS6520 SCREENED |
| Q 210 | 1 | 48-80368A92 | TRANSISTOR | MPS6519 SCREENED |
| Q 211 | 1 | 48-80368A92 | TRANSISTOR | MPS6519 SCREENED |
| Q 212 | 1 | 48-80345A47 | TRANSISTOR | |
| Q 213 | 1 | 48R00869870 | TRANSISTOR | |
| Q 214 | 1 | 48R00869870 | TRANSISTOR | |
| Q 218 | 1 | 48-80346A45 | TRANSISTOR | |
| Q 219 | 1 | 48-2089C01 | TRANSISTOR | |
| Q 220 | 1 | 48R00869870 | TRANSISTOR | |
| Q 221 | 1 | 48-80368A91 | TRANSISTOR | MPS6520 SCREENED |
| Q 222 | 1 | 48-80368A91 | TRANSISTOR | MPS6520 SCREENED |
| Q 223 | 1 | 48-869933 | TRANSISTOR | |
| Q 224 | 1 | 48-84309A61 | TRANSISTOR | |

| Find No. | Qty. Req. | Part No. | Nomenclature | Part Value |
|---|---|---|---|---|
| Q 225 | 1 | 48-84309A61 | TRANSISTOR | |
| Q 226 | 1 | 48-84309A61 | TRANSISTOR | |
| Q 227 | 1 | 48-869933 | TRANSISTOR | |
| Q 228 | 1 | 48-80368A92 | TRANSISTOR | MPS6519 SCREENED |
| Q 229 | 1 | 48-84308A92 | TRANSISTOR | |
| Q 230 | 1 | 48-86851C32 | TRANSISTOR | |
| Q 231 | 1 | 48-869145 | TRANSISTOR | |
| Q 233 | 1 | 48-2089C01 | TRANSISTOR | |
| R 201 | 1 | 6S124A18 | RESISTOR | 51-5-1/4 |
| R 202 | 1 | 6S124A41 | RESISTOR | 470-5-1/4 |
| R 203 | 1 | 6S124A41 | RESISTOR | 470-5-1/4 |
| R 204 | 1 | 6S124A25 | RESISTOR | 100-5-1/4 |
| R 205 | 1 | 6S185A25 | RESISTOR | 100-5-1/8 |
| R 206 | 1 | 6S124A41 | RESISTOR | 470-5-1/4 |
| R 207 | 1 | 6S124A41 | RESISTOR | 470-5-1/4 |
| R 208 | 1 | 6S124A41 | RESISTOR | 470-5-1/4 |
| R 209 | 1 | 6S124A41 | RESISTOR | 470-5-1/4 |
| R 210 | 1 | 6S124A41 | RESISTOR | 470-5-1/4 |
| R 211 | 1 | 6S124A41 | RESISTOR | 470-5-1/4 |
| R 212 | 1 | 6S185A53 | RESISTOR | 1.5K-5-1/8 |
| R 213 | 1 | 6S124A31 | RESISTOR | 180-5-1/4 |
| R 214 | 1 | 6S124A31 | RESISTOR | 180-5-1/4 |
| R 215 | 1 | 6S124A15 | RESISTOR | 39-5-1/4 |
| R 216 | 1 | 6S124A41 | RESISTOR | 470-5-1/4 |
| R 217 | 1 | 6S124A41 | RESISTOR | 470-5-1/4 |
| R 218 | 1 | 6S124A59 | RESISTOR | 2.7K-5-1/4 |
| R 219 | 1 | 6S124A59 | RESISTOR | 2.7K-5-1/4 |
| R 220 | 1 | 6S124A79 | RESISTOR | 18K-5 1/4 |
| R 221 | 1 | 6S124A59 | RESISTOR | 2.7K-5-1/4 |
| R 222 | 1 | 6S124A59 | RESISTOR | 2 7K-5-1/4 |
| R 223 | 1 | 6S124A79 | RESISTOR | 18K-5-1/4 |
| R 224 | 1 | 6S124A49 | RESISTOR | 1K-5-1/4 |
| R 225 | 1 | 6S124A79 | RESISTOR | 18K-5-1/4 |
| R 227 | 1 | 6S124A43 | RESISTOR | 560-5-1/4 |
| R 228 | 1 | 6S124A29 | RESISTOR | 150-5-1/4 |
| R 229 | 1 | 6S124A29 | RESISTOR | 150-5-1/4 |
| R 230 | 1 | 6S185A73 | RESISTOR | 10K-5-1/8 |
| R 231 | 1 | 6S124A25 | RESISTOR | 100-5-1/4 |
| R 232 | 1 | 6S185A33 | RESISTOR | 220-5-1/8 |
| R 233 | 1 | 6S185A33 | RESISTOR | 220-5-1/8 |
| R 234 | 1 | 6S185A09 | RESISTOR | 22-5-1/8 |
| R 235 | 1 | 6S185A85 | RESISTOR | 33K-5-1/8 |
| R 236 | S01 | 6S185A95 | RESISTOR | 82K-5-1/8 |
| R 236 | 1 | 6S185A90 | RESISTOR | 51K-5-1/8 |
| R 236 | S01 | 6S185A93 | RESISTOR | 68K-5-1/8 |
| R 237 | 1 | 6S185A47 | RESISTOR | 820-5-1/8 |
| R 238 | 1 | 6S185A49 | RESISTOR | 1K-5-1/8 |
| R 239 | 1 | 6S124A25 | RESISTOR | 100-5-1/4 |
| R 240 | 1 | 6S185A18 | RESISTOR | 51-5-1/8 |
| R 241 | 1 | 6S185A41 | RESISTOR | 470-5-1/8 |
| R 242 | 1 | 6S185A43 | RESISTOR | 560-5-1/8 |
| R 243 | 1 | 6S185A43 | RESISTOR | 560-5-1/8 |
| R 244 | 1 | 6S185A53 | RESISTOR | 1.5K-5-1/8 |
| R 245 | 1 | 6S185A33 | RESISTOR | 220-5-1/8 |
| R 246 | 1 | 6S185A33 | RESISTOR | 220-5-1/8 |
| R 247 | 1 | 6S124A31 | RESISTOR | 180-5-1/4 |
| R 248 | 1 | 6S185A05 | RESISTOR | 15-5-1/8 |
| R 249 | 1 | 6S185A05 | RESISTOR | 15-5-1/8 |
| R 250 | 1 | 6S124A97 | RESISTOR | 100K-5-1/4 |
| R 251 | 1 | 6S124A85 | RESISTOR | 33K-5-1/4 |
| R 252 | 1 | 6S185A57 | RESISTOR | 2.2K-5-1/8 |
| R 253 | 1 | 6S185A49 | RESISTOR | 1K-5-1/8 |

Figure 11-7. RF Synthesizer A5A2 (RTC-4010B) Parts Location Diagram

| No. | Req. | Part No. | Nomenclature | Part Value |
|---|---|---|---|---|
| R 254 | 1 | 6S185AS3 | RESISTOR | 1.5K-S-1/8 |
| R 255 | 1 | 6S185A45 | RESISTOR | 680-S-1/8 |
| R 256 | S01 | 6S185A09 | RESISTOR | 22-S-1/8 |
| R 256 | S01 | | WIRE,SOLID BUS | #24 |
| R 256 | S01 | 6S185A01 | RESISTOR | 10-S-1/8 |
| R 257 | 1 | 6S185A09 | RESISTOR | 22-S-1/8 |
| R 258 | 1 | 6S185A21 | RESISTOR | 68-S-1/8 |
| R 259 | 1 | 6S185A49 | RESISTOR | 1K-S-1/8 |
| R 260 | 1 | 6S185A49 | RESISTOR | 1K-S-1/8 |
| R 261 | 1 | 6S185A49 | RESISTOR | 1K-S-1/8 |
| R 262 | 1 | 6S185A49 | RESISTOR | 1K-S-1/8 |
| R 263 | 1 | 6S185A49 | RESISTOR | 1K-S-1/8 |
| R 264 | 1 | 6S185A49 | RESISTOR | 1K-S-1/8 |
| R 265 | 1 | 6S124A73 | RESISTOR | 10K-S-1/4 |
| R 266 | 1 | 6S124A65 | RESISTOR | 4.7K-S-1/4 |
| R 267 | 1 | 6S185AS7 | RESISTOR | 2.2K-S-1/8 |
| R 268 | 1 | 6S185A65 | RESISTOR | 4.7K-S-1/8 |
| R 269 | 1 | 6S185A59 | RESISTOR | 2.7K-S-1/8 |
| R 270 | 1 | 6S185A75 | RESISTOR | 12K-S-1/8 |
| R 271 | 1 | 6S185A67 | RESISTOR | 5.6K-S-1/8 |
| R 272 | 1 | 6S185A29 | RESISTOR | 150-S-1/8 |
| R 273 | 1 | 6S185A71 | RESISTOR | 8.2K-S-1/8 |
| R 274 | 1 | 6S185A75 | RESISTOR | 12K-S-1/8 |
| R 275 | 1 | 6S185A37 | RESISTOR | 330-S-1/8 |
| R 276 | 1 | 6S185A29 | RESISTOR | 150-S-1/8 |
| R 277 | 1 | 6S124A31 | RESISTOR | 180-S-1/4 |
| R 278 | 1 | 6S185A17 | RESISTOR | 47 S 1/8 |
| R 279 | 1 | 6S185A05 | RESISTOR | 15 S-1/8 |
| R 281 | 1 | 6S185AS3 | RESISTOR | 1.5K-S-1/8 |
| R 282 | 1 | 6S185A33 | RESISTOR | 220-S-1/8 |
| R 283 | 1 | 6S185A33 | RESISTOR | 220-S-1/8 |
| R 284 | 1 | 6S185A05 | RESISTOR | 15-S-1/8 |
| R 285 | 1 | 6S185A05 | RESISTOR | 15-S-1/8 |
| R 286 | 1 | 6S185A27 | RESISTOR | 120-S-1/8 |
| R 287 | 1 | 6S185A21 | RESISTOR | 68-S-1/8 |
| R 288 | 1 | 6S185A27 | RESISTOR | 120-S-1/8 |
| R 295 | 1 | 6S185A31 | RESISTOR | 180-S-1/8 |
| R 296 | 1 | 6S185A15 | RESISTOR | 39-S-1/8 |
| R 297 | 1 | 6S185A18 | RESISTOR | 51-S-1/8 |
| R 298 | 1 | 6S185A41 | RESISTOR | 470-S-1/8 |
| R 299 | 1 | 6S185A41 | RESISTOR | 470-S-1/8 |
| R 300 | 1 | 6S185A18 | RESISTOR | 51-S-1/8 |
| R 301 | 1 | 6S124A15 | RESISTOR | 39-S-1/4 |
| R 304 | 1 | 6S124A45 | RESISTOR | 680-S-1/4 |
| R 305 | 1 | 6S124A35 | RESISTOR | 270-S-1/4 |
| R 307 | 1 | 6S124A15 | RESISTOR | 39-S-1/4 |
| R 308 | 1 | 6S124A49 | RESISTOR | 1K-S-1/4 |
| R 309 | 1 | 6S124A59 | RESISTOR | 2.7K-S-1/4 |
| R 310 | 1 | 6S124A73 | RESISTOR | 10K-S-1/4 |
| R 311 | 1 | 6S124A73 | RESISTOR | 10K-S-1/4 |
| R 312 | 1 | 6S124A73 | RESISTOR | 10K-S-1/4 |
| R 313 | 1 | 6S124A73 | RESISTOR | 10K-S-1/4 |
| R 314 | 1 | 6S124A53 | RESISTOR | 1.5K-S-1/4 |
| R 315 | 1 | 6S124A53 | RESISTOR | 1.5K-S-1/4 |
| R 319 | 1 | 6S185AS7 | RESISTOR | 2.2K-S-1/8 |
| R 320 | 1 | 6S185A94 | RESISTOR | 75K-S-1/8 |
| R 321 | 1 | 6S185A97 | RESISTOR | 100K-S-1/8 |
| R 322 | 1 | 6S185A49 | RESISTOR | 1K-S-1/8 |
| R 323 | 1 | 6S185A73 | RESISTOR | 10K-S-1/8 |
| R 324 | 1 | 6S124A36 | RESISTOR | 300-S-1/4 |
| R 325 | 1 | 6S124A07 | RESISTOR | 18-S-1/4 |
| R 326 | 1 | 6S124A36 | RESISTOR | 300-S-1/4 |
| R 327 | 1 | 6S124A43 | RESISTOR | 560-S-1/4 |
| R 328 | 1 | 6S124A65 | RESISTOR | 4.7K-S-1/4 |
| R 329 | 1 | 6S185A41 | RESISTOR | 470-S-1/4 |
| R 330 | 1 | 6S185A75 | RESISTOR | 12K-S-1/8 |
| R 331 | 1 | 6S124A41 | RESISTOR | 470-S-1/4 |

| Find No. | Qty. Req. | Part No. | Nomenclature | Part Value |
|---|---|---|---|---|
| R 332 | 1 | 6S185A36 | RESISTOR | 300-S-1/8 |
| R 333 | 1 | 6S185A36 | RESISTOR | 300-S-1/8 |
| R 334 | 1 | 6S185A07 | RESISTOR | 18-S-1/8 |
| R 335 | 1 | 6S185A18 | RESISTOR | 51-S-1/8 |
| R 336 | 1 | 6S185AS3 | RESISTOR | 1.5K-S-1/8 |
| R 337 | 1 | 6S185A05 | RESISTOR | 15-S-1/8 |
| R 338 | 1 | 6S185A05 | RESISTOR | 15-S-1/8 |
| R 339 | 1 | 6S185A18 | RESISTOR | 51-S-1/4 |
| R 340 | 1 | 6S185A31 | RESISTOR | 180-S-1/8 |
| R 341 | 1 | 6S185A13 | RESISTOR | 33-S-1/8 |
| R 342 | 1 | 6S185A27 | RESISTOR | 120-S-1/8 |
| R 343 | 1 | 6S185A47 | RESISTOR | 820-S-1/8 |
| R 344 | 1 | 6S185A49 | RESISTOR | 1K-S-1/8 |
| R 345 | 1 | 6S185A43 | RESISTOR | 560-S-1/8 |
| R 346 | 1 | 6S185A43 | RESISTOR | 560-S-1/8 |
| R 347 | 1 | 6S185A41 | RESISTOR | 470-S-1/8 |
| R 348 | 1 | 6S185A21 | RESISTOR | 68-S-1/8 |
| R 349 | 1 | 6S185A61 | RESISTOR | 3.3K-S-1/8 |
| R 350 | 1 | 6S185A59 | RESISTOR | 2.7K-S-1/8 |
| R 351 | 1 | 6S185A35 | RESISTOR | 270-S-1/8 |
| R 352 | 1 | 6S124A55 | RESISTOR | 1.8K-S-1/4 |
| R 353 | 1 | 6S124A35 | RESISTOR | 270-S-1/4 |
| R 354 | 1 | 18083452F16 | RESISTOR,VARIABLE | 20K |
| R 355 | 1 | 06-80396A75 | RESISTOR | 309K-1-1/4 NOMINA |
| R 355 | S01 | 06-80396A74 | RESISTOR | 301K-1-1/4 |
| R 355 | S01 | 06-80396A76 | RESISTOR | 316K-1-1/4 |
| R 356 | 1 | 06-10621D36 | RESISTOR | 28.7K-1-1/8 |
| R 357 | 1 | 6S185A05 | RESISTOR | 15-S-1/8 |
| R 358 | S01 | 06-10621D56 | RESISTOR | 46.4K-1-1/8 |
| R 358 | S01 | 06-10621D48 | RESISTOR | 38.3K-1-1/8 |
| R 358 | S01 | 06-10621D52 | RESISTOR | 42.2K-1-1/8 |
| R 358 | S01 | RN55D5112F | RESISTOR | 51.1K-1-1/8 |
| R 358 | S01 | 06-10621D64 | RESISTOR | 56.2K-1-1/8 |
| R 358 | S01 | 06-10621D68 | RESISTOR | 61.9K-1-1/8 |
| R 359 | 1 | 06-10621D36 | RESISTOR | 28.7K-1-1/8 |
| R 360 | 1 | 06-10621D36 | RESISTOR | 28.7K-1-1/8 |
| R 361 | 1 | 6S124A83 | RESISTOR | 27K-S-1/4 |
| R 362 | 1 | 6S124A97 | RESISTOR | 100K-S-1/4 |
| R 363 | 1 | 6S124A73 | RESISTOR | 10K-S-1/4 |
| R 364 | 1 | 6S124A73 | RESISTOR | 10K-S-1/4 |
| R 365 | 1 | 6S124A73 | RESISTOR | 10K-S-1/4 |
| R 366 | 1 | 6S124A73 | RESISTOR | 10K-S-1/4 |
| R 367 | 1 | 6S124A73 | RESISTOR | 10K-S-1/4 |
| R 368 | 1 | 6S124A56 | RESISTOR | 2.0K-S-1/4 |
| R 369 | 1 | 06-10621D60 | RESISTOR | 51.1-1-1/8 |
| R 370 | 1 | 06-10621C27 | RESISTOR | 2150-1-1/8 |
| R 371 | 1 | 06-10621E04 | RESISTOR | 143K-1-1/8 |
| R 372 | 1 | 06-10621D74 | RESISTOR | 71.5K-1-1/8 |
| R 373 | 1 | 06-10621D44 | RESISTOR | 34.8K-1-1/8 |
| R 374 | 1 | 06-10621D12 | RESISTOR | 16.2K-1-1/8 |
| R 375 | 1 | 6S124A73 | RESISTOR | 10K-S-1/4 |
| R 376 | 1 | 6S185A05 | RESISTOR | 15-S-1/8 |
| R 377 | 1 | 6S124A90 | RESISTOR | 51K-S-1/4 |
| R 378 | 1 | 6S124A96 | RESISTOR | 91K-S-1/4 |
| R 379 | 1 | 6S124A81 | RESISTOR | 22K-S-1/4 |
| R 380 | 1 | 6S124A61 | RESISTOR | 3.3K-S-1/4 |
| R 381 | 1 | 6S124A91 | RESISTOR | 56K-S-1/4 |
| R 382 | 1 | 6S124A56 | RESISTOR | 2.0K-S-1/4 |
| R 383 | 1 | 6S124A81 | RESISTOR | 22K-S-1/4 |
| R 384 | 1 | 6S124A99 | RESISTOR | 120K-S-1/4 |
| R 385 | 1 | 6S124A73 | RESISTOR | 10K-S-1/4 |
| R 386 | 1 | 6S124A25 | RESISTOR | 100-S-1/4 |
| R 387 | 1 | 6S185A24 | RESISTOR | 91-S-1/8 |
| R 389 | 1 | 6S124A73 | RESISTOR | 10K-S-1/4 |
| R 390 | 1 | 6S124A25 | RESISTOR | 100-S-1/4 |
| R 391 | 1 | 6S124A97 | RESISTOR | 100K-S-1/4 |
| R 392 | 1 | 6S124A79 | RESISTOR | 18K-S-1/4 |

| Find No. | Qty. Req. | Part No. | Nomenclature | Part Value |
|---|---|---|---|---|
| R 393 | 1 | 6S124A25 | RESISTOR | 100-S-1/4 |
| R 394 | 1 | 6S124A75 | RESISTOR | 12K-S-1/4 |
| R 395 | 1 | 6S124A75 | RESISTOR | 12K-S-1/4 |
| R 396 | 1 | 6S124A01 | RESISTOR | 10-S-1/4 |
| R 397 | 1 | 6S124A73 | RESISTOR | 10K-S-1/4 |
| R 398 | 1 | 6S124A47 | RESISTOR | 820-S-1/4 |
| R 399 | 1 | 6S124A51 | RESISTOR | 1.2K-S-1/4 |
| R 400 | 1 | 6S124A01 | RESISTOR | 10-S-1/4 |
| R 401 | 1 | 6S124A49 | RESISTOR | 1K-S-1/4 |
| R 402 | 1 | 6S124A49 | RESISTOR | 1K-S-1/4 |
| R 403 | 1 | 6S124A49 | RESISTOR | 1K-S-1/4 |
| R 404 | 1 | 6S185A49 | RESISTOR | 1K-S-1/8 |
| R 405 | 1 | 6S124A73 | RESISTOR | 10K-S-1/4 |
| R 406 | 1 | 6S124A49 | RESISTOR | 1K-S-1/4 |
| R 407 | 1 | 6S185A56 | RESISTOR | 2.0K-S-1/8 |
| R 408 | 1 | 6S124A25 | RESISTOR | 100-S-1/4 |
| R 409 | 1 | 6S185A49 | RESISTOR | 1K-S-1/8 |
| R 410 | 1 | 6S185A61 | RESISTOR | 3.3K-S-1/8 |
| R 411 | 1 | 6S185A49 | RESISTOR | 1K-S-1/8 |
| R 412 | 1 | 6S185A41 | RESISTOR | 470-S-1/8 |
| R 413 | 1 | 6S185A45 | RESISTOR | 680-S-1/8 |
| R 414 | 1 | 6S124A37 | RESISTOR | 330-S-1/4 |
| R 415 | 1 | 6S124A37 | RESISTOR | 330-S-1/4 |
| R 416 | 1 | 6S185A65 | RESISTOR | 4.7K-S-1/8 |
| R 417 | 1 | 6S124A31 | RESISTOR | 180-S-1/4 |
| R 418 | 1 | 6S185A33 | RESISTOR | 220-S-1/8 |
| R 419 | 1 | 6S185A31 | RESISTOR | 180-S-1/8 |
| R 420 | 1 | 6S185A31 | RESISTOR | 180-S-1/8 |
| R 421 | 1 | 6S185A13 | RESISTOR | 33-S-1/8 |
| R 422 | 1 | 6S185A33 | RESISTOR | 220-S-1/8 |
| R 423 | 1 | 6S185A53 | RESISTOR | 1.5K-S-1/8 |
| R 424 | 1 | 6S185A51 | RESISTOR | 1.2K-S-1/8 |
| R 425 | 1 | 6S185A65 | RESISTOR | 4.7K-S-1/8 |
| R 426 | 1 | 6S185A67 | RESISTOR | 5.6K-S-1/8 |
| R 427 | 1 | 6S185A37 | RESISTOR | 330-S-1/8 |
| R 428 | 1 | 6S185A37 | RESISTOR | 330-S-1/8 |
| R 429 | 1 | 6S124A33 | RESISTOR | 220-S-1/4 |
| R 430 | 1 | 6S185A27 | RESISTOR | 120-S-1/8 |
| R 431 | 1 | 6S185A21 | RESISTOR | 68-S-1/8 |
| R 432 | 1 | 6S185A37 | RESISTOR | 330-S-1/8 |
| R 435 | 1 | 6S124A56 | RESISTOR | 2.0K-S-1/4 |
| R 436 | 1 | 6S185A25 | RESISTOR | 100-S-1/8 |
| R 437 | S01 | 6S185A23 | RESISTOR | 82-S-1/8 |
| R 438 | 1 | 6S185A81 | RESISTOR | 22K-S-1/8 |
| R 439 | 1 | 6S185A81 | RESISTOR | 22K-S-1/8 |
| T 201 | 1 | 24-80369A53 | TRANSFORMER | |
| T 202 | 1 | 24-80369A53 | TRANSFORMER | |
| U 201 | 1 | 51-80345A33 | INTEGRATED CIRCUIT | |
| U 202 | 1 | 51-80345A14 | INTEGRATED CIRCUIT | MC10138L SCREENED |
| U 203 | 1 | 51-80321A69 | INTEGRATED CIRCUIT | MC12040L SCREENED |
| U 204 | 1 | 51-80345A01 | INTEGRATED CIRCUIT | CA3140E SCREENED |
| U 205 | 1 | 51-80323A60 | INTEGRATED CIRCUIT | MC10116P SCREENED |
| U 206 | 1 | 51-80346A05 | MIXER | |
| U 207 | 1 | 51-80396A16 | INTEGRATED CIRCUIT | LM324N SCREENED |
| U 208 | 1 | 51-80396A09 | INTEGRATED CIRCUIT | |
| U 209 | 1 | 51-80346A05 | MIXER | |
| U 210 | 1 | 51-80345A10 | INTEGRATED CIRCUIT | LM393N SCREENED |
| U 211 | 1 | 51-80345A30 | INTEGRATED CIRCUIT | NE5534AN SCREENED |

Figure 11-7. RF Synthesizer A5A2 (RTC-4010B)
Parts Location Diagram

| Find No. | Qty. Req. | Part No. | Nomenclature | Part Value |
|---|---|---|---|---|
| U 212 | 1 | 51-80346A54 | INTEGRATED CIRCUIT | |
| U 213 | 1 | 51-80368A38 | INTEGRATED CIRCUIT | MC14052BCP SCREENE |
| U 214 | 1 | 51-80368A55 | INTEGRATED CIRCUIT | MM74C906N SCREENED |
| U 215 | 1 | 51-80345A04 | INTEGRATED CIRCUIT | CA3240E SCREENED |
| U 216 | 1 | 51-80368A37 | INTEGRATED CIRCUIT | MC14051BCP SCREENE |
| U 217 | 1 | 51-80345A01 | INTEGRATED CIRCUIT | CA3140E SCREENED |
| U 218 | 1 | 51-80345A23 | INTEGRATED CIRCUIT | MC1733CP SCREENED |
| U 219 | 1 | 51-83222M05 | INTEGRATED CIRCUIT | MC1496P SCREENED |
| U 220 | 1 | 51-80346A54 | INTEGRATED CIRCUIT | |
| U 221 | 1 | 51-80369A07 | INTEGRATED CORCUIT | |
| VR201 | 1 | 48-83193A59 | DIODE ZENNER | 5 6V-5- 4 |
| VR202 | 1 | 48-82256C44 | DIODE,ZENER | 7 5V-5- 4 |
| VR203 | 1 | 48-82256C44 | DIODE ZENER | 7 5V-5- 4 |
| VR204 | 1 | 48-82256C44 | DIODE,ZENER | 7 5V-5- 4 |
| VR205 | 1 | 48-82256C44 | DIODE ZENER | 7 5V-5- 4 |
| VR206 | 1 | 48-82256C11 | DIODE ZENER | 10V-5- 4 |
| VR207 | 1 | 48-82256C11 | DIODE ZENER | 10V-5- 4 |
| VR208 | 1 | 48-80345A78 | DIODE | 11V-5- 4 |
| VR209 | 1 | 48-86850C13 | DIODE,ZENER | 5 1V-5- 4 |
| VR210 | 1 | 48-80345A78 | DIODE | 11V-5- 4 |

Figure 11-7. RF Synthesizer A5A2 (RTC-4010B) Parts Location Diagram (Sheet 6 of 6)

# SECTION 12
# AUDIO SYNTHESIZER (A6)

**12-1. General.** Generation, processing, and control of modulation audio is the function of the Audio Synthesizer module. Three modulation signals, private line, digital private line, and a fixed 1 kHz, are generated on the board. Processing for external microphone and BNC jack audio inputs as well as summation of all modulation sources to form a composite source is provided. Switching of the composite source to the appropriate modulator completes the function of the Audio Synthesizer. A block diagram of the Audio Synthesizer is shown in figure 12-1 with its schematic in figure 12-2.

**12-2. Private Line Generator.** Private line tones from 10 Hz to 10 kHz in 0.1 Hz increments are synthesized using a phase accumulative technique. Consider the 360 degrees in a cycle to be divided into $2^{20}$ pieces. A 20 bit digital accumulator incrementing at some fixed rate could then at any instant represent a fixed point in the 360 cycle. That is, if the accumulator was half full it would represent the 180° point and if totally full would represent the 360° point.

12-3. The number of times per second that the accumulator goes through its complete cycle determines the output frequency. If the increment rate is fixed, the time required to accumulate $2^{20}$ bits can be changed by changing the number of bits added at each increment time.

12-4. The PL synthesizer increments at a 104 857.6 Hz rate so that if only one bit were added each time, the time to complete one cycle would be 10 seconds. Processor loaded control latches determine the number of bits to be added at each increment time and thus the final output frequency. A 20 Bit Adder adds the control word to the current word in the 20 bit accumulator Latch. At the next increment time the Adder output is latched and becomes the next input to the Adder.

12-5. Conversion of the linear digital output of the 20-Bit Latch accumulator into a sinusoidal digital output is the function of the Decode ROM. A Digital to Analog (D/A) converter following the ROM converts the sinusoidal information into a quantized sinewave having a period equal to the cycle time of the 20-Bit Latch accumulator.

12-6. A bandpass filter with a 10 Hz to 10 kHz passband filters the quantized waveform to a sinewave having less than 1% distortion. The level of the sinewave is processor controllable by a programmable attenuator having 0, 10, 20, and 30 dB settings. The output of the PL generator is switched with the output of the DPL generator to give the INT MOD signal.

**12-7. DPL Generator.** The 23 bit Digital Private Line (DPL) word is generated by the processor from the 3-digit code. The 23-bit word is then transferred to a serial shift register and clocked out at a 133 Hz rate. Connecting the output of the shift register back to its input causes the 23-bit word to be continuously repeated.

12-8. A 133 Hz tone from the PL generator is the DPL clock input. For the DPL output mode the tone is gated to the clock input of the shift register by the Shift Register Control circuit. During the load mode the Shift Register Control gates a control latch to the shift register input. Twenty three data bits and clock pulses are then provided by the processor to load the DPL word. At the completion of the load mode, the Shift Register Control switches back to the output mode to cause the DPL word to be cycled through the shift register at the 133 Hz rate.

12-9. A bandpass filter following the shift register output removes the higher frequency components of the digital signal. The filtered DPL signal is then applied to the select switch. For the DPL off code (133 Hz tone), the processor switches the INT MOD line to the PL output so that a 133 Hz sinewave is output.

**12-10. 1 kHz Tone.** A filtered 1 kHz square wave provides the fixed 1 kHz modulation source. The SYNTH 1 kHz signal from the RF Synthesizer is filtered to less than 1% distortion by a bandpass filter. The filter output is the 1 kHz signal source.

**12-11. External Modulation.** A microphone and a front panel jack are the external modulation inputs. An Instantaneous Deviation Control (IDC) circuit amplifies and limits the microphone signal (MIC IN) before summation with the signal (EXT MOD IN) from the front panel jack. The summation signal is the EXT MOD source.

**12-12. Modulation Control.** Level control of the three modulation sources is by either the front panel controls or the IEEE interface module. The level adjusted sources are then returned to the Audio Synthesizer module where they are summed together to form the composite modulation audio. The composite signal is then routed to the Scope/ DVM Control module (MOD CAL AUDIO) for modulation determination, to a buffer amp which drives the front panel modulation output (MOD TO FP), and to a Modulation Select Switch which routes the signal to the desired modulator.

12-13. Modulation audio is switched to the speaker (VOL CNTL AUDIO) for any generate mode, to the DSBSC modulator (DSBSC MOD) for sideband modulation, to the RF Synthesizer for frequency modulation (FM MOD), to the offset oscillator for frequency modulation of the duplex output (OFFSET MOD), and to the RF output leveling loop for amplitude modulation. The signal for amplitude modulation is summed with a 5 VDC level and then routed to the variable RF level control on the front panel (5 VDC + AM MOD). At the RF level control the signal is attenuated according to the level setting to give the DC plus AM reference signal for the output leveling loop.

**12-14. Module Control.** Processor control of the Audio Synthesizer is via the AF control bus. The four bit address bus (AF ADD BUS 0-3) is decoded by the Address Decoder to determine which control latch is to be accessed. Control data is transferred to the accessed latch on the four bit data bus (AF DATA BUS 0-3).Synchronization of the data transfer is the function of the AF BUS EN1 signal line.

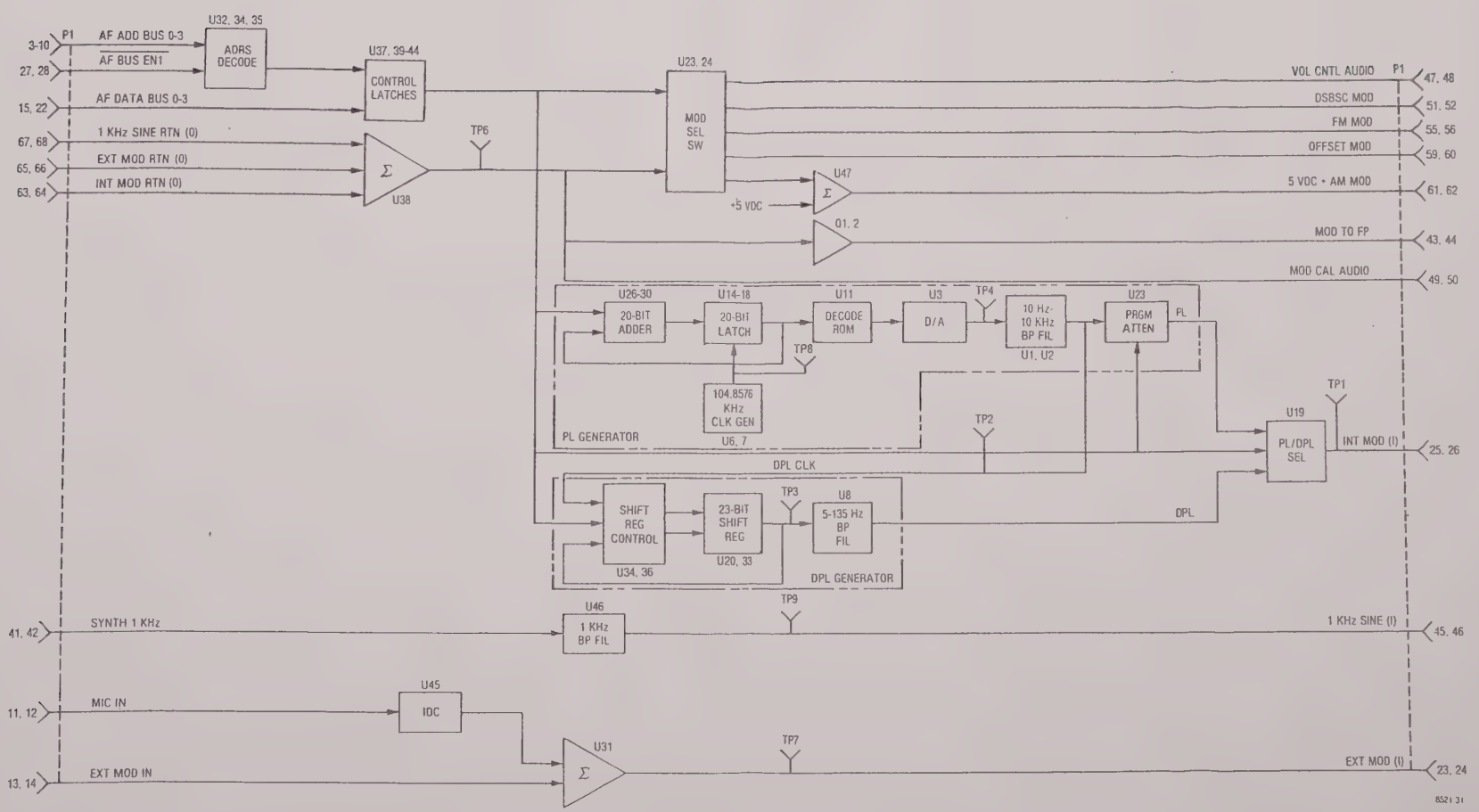



Figure 12-1. Audio Synthesizer A6 Block Diagram

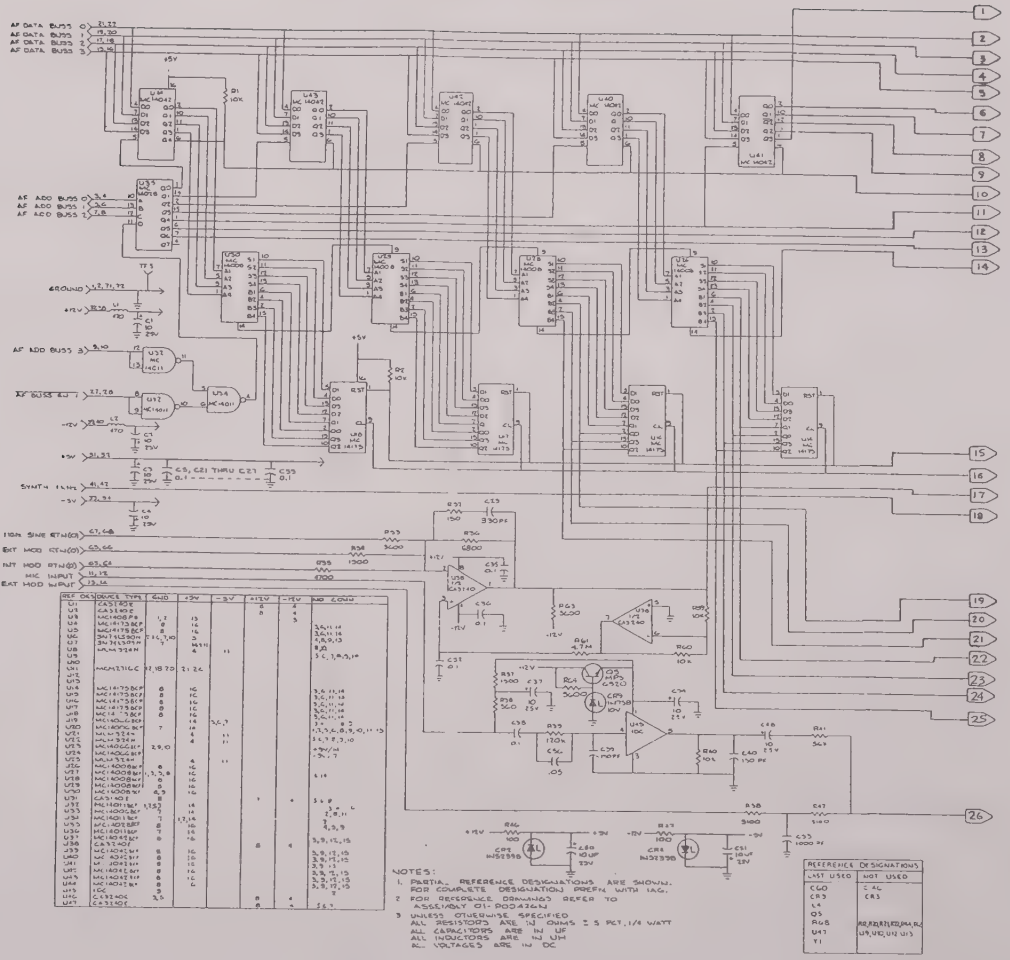


Figure 12-2. Audio Synthesizer A6 Schematic Diagram (Sheet 1 of 2)

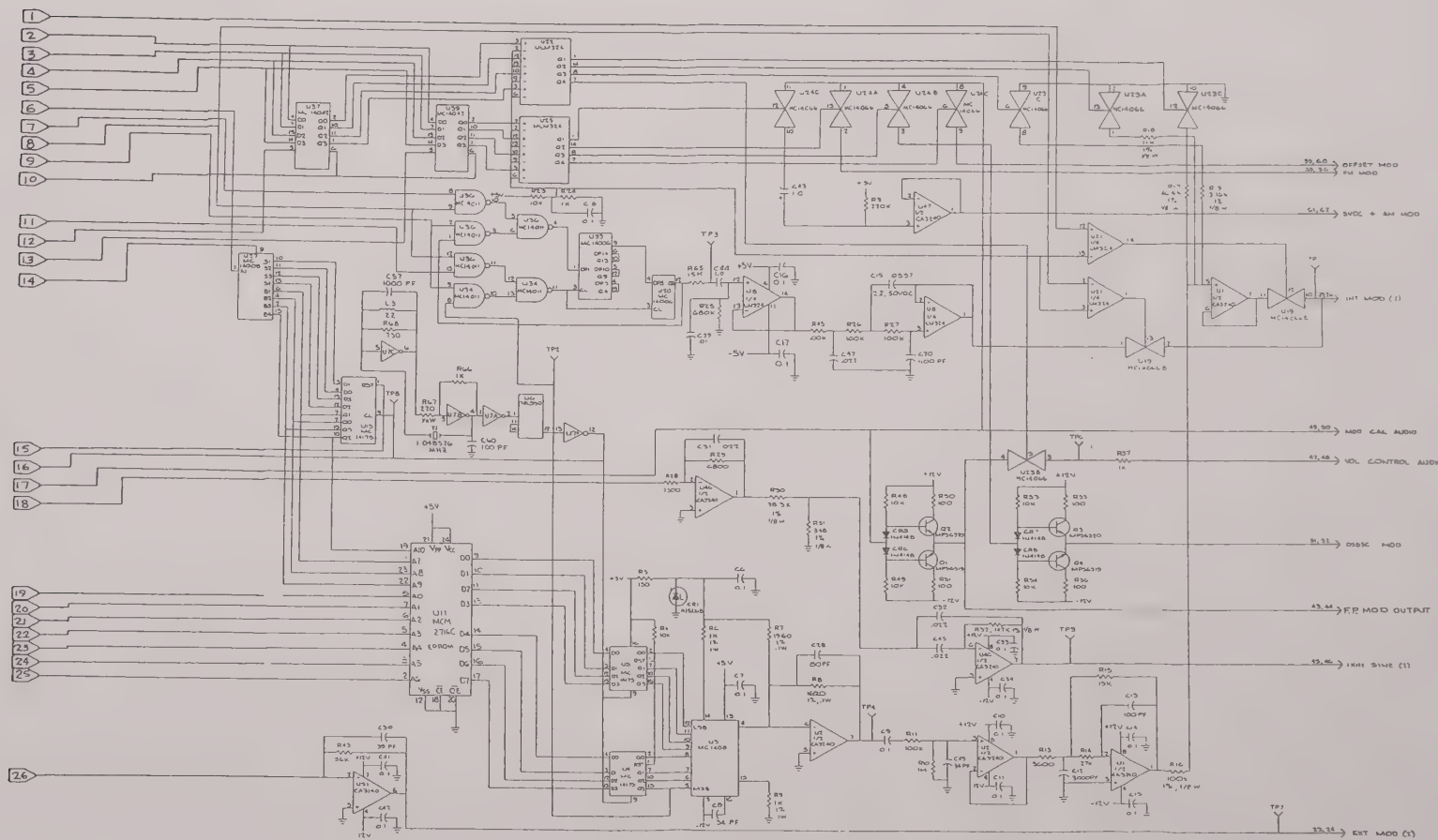


Figure 12-2. Audio Synthesizer A6 Schematic Diagram (Sheet 2 of 2)

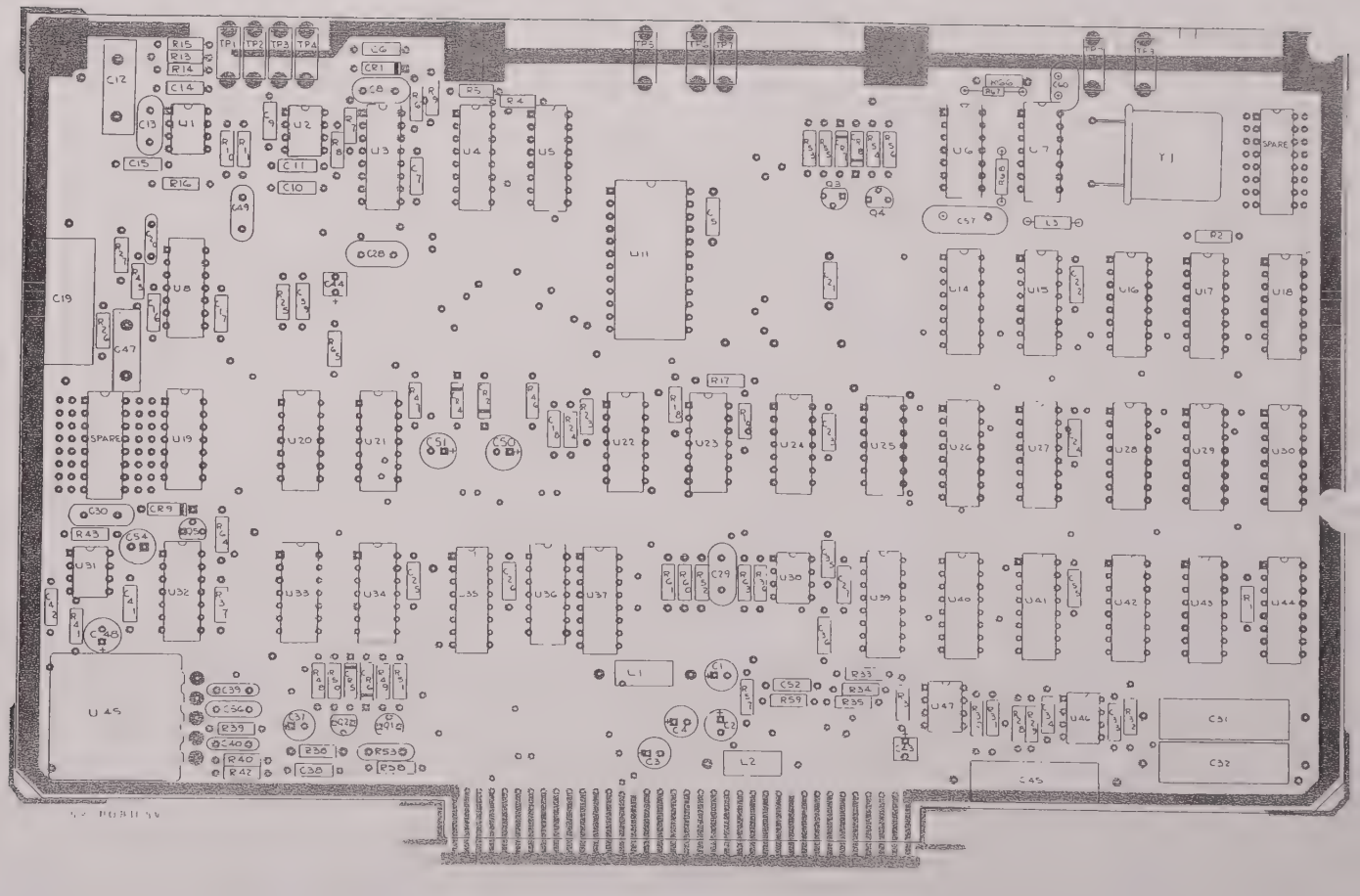



Figure 12-3. Audio Synthesizer A6 (RTC-4011B)
Parts Location Diagram
(Sheet 1 of 3)

| Find No. | Qty. Req. | Part No. | Nomenclature | Part Value |
|---|---|---|---|---|
| | | RTC-4011B | AUDIO SYNTHESIZER | |
| 001 | 1 | 84-P08108V001 | PWB AUDIO SYNTHESI | |
| 002 | 1 | 07-80335A63 | BRACKET,PWB MTG | |
| 003 | 4 | MS20470AD4-5 | RIVET | 1/8X.312 |
| 004 | AR | SN63WRP3 | SOLDER | |
| 005 | AR | 11-14167A01 | INK | BLACK |
| 006 | 2 | 5C84500B03 | EYELET | |
| 007 | 2 | 42C84284B01 | RETAINER | |
| 008 | 2 | 03-139581 | SCREW,PH | 4-40X.312 |
| 009 | AR | RTV3145 | ADHESIVE,SIL RUBBE | |
| C 001 | 1 | 23-80396A40 | CAPACITOR | 10UF-25V |
| C 002 | 1 | 23-80396A40 | CAPACITOR | 10UF-25V |
| C 003 | 1 | 23-80396A40 | CAPACITOR | 10UF-25V |
| C 004 | 1 | 23-80396A40 | CAPACITOR | 10UF-25V |
| C 005 | 1 | 21-80396A49 | CAPACITOR | .1UF-20-100 |
| C 006 | 1 | 21-80396A49 | CAPACITOR | .1UF-20-100 |
| C 007 | 1 | 21-80396A49 | CAPACITOR | .1UF-20-100 |
| C 008 | 1 | 21D84494B30 | CAPACITOR | 34PF-5-500 |
| C 009 | 1 | 21-80396A49 | CAPACITOR | .1UF-20-100 |
| C 010 | 1 | 21-80396A49 | CAPACITOR | .1UF-20-100 |
| C 011 | 1 | 21-80396A49 | CAPACITOR | .1UF-20-100 |
| C 012 | 1 | 21K863395 | CAPACITOR | 3000PF-2-500 |
| C 013 | 1 | 21D84494B04 | CAPACITOR | 100PF-5-500 |
| C 014 | 1 | 21-80396A49 | CAPACITOR | .1UF-20-100 |
| C 015 | 1 | 21-80396A49 | CAPACITOR | .1UF-20-100 |
| C 016 | 1 | 21-80396A49 | CAPACITOR | .1UF-20-100 |
| C 017 | 1 | 21-80396A49 | CAPACITOR | .1UF-20-100 |
| C 018 | 1 | 21-80396A49 | CAPACITOR | .1UF-20-100 |
| C 019 | 1 | 08D84326A27 | CAPACITOR | .0557UF-2-50 |
| C 020 | 1 | 21D83596E32 | CAPACITOR | 1100PF-5-200 |
| C 021 | 1 | 21-80396A49 | CAPACITOR | .1UF-20-100 |
| C 022 | 1 | 21-80396A49 | CAPACITOR | .1UF-20-100 |
| C 023 | 1 | 21-80396A49 | CAPACITOR | .1UF-20-100 |
| C 024 | 1 | 21-80396A49 | CAPACITOR | .1UF-20-100 |
| C 025 | 1 | 21-80396A49 | CAPACITOR | .1UF-20-100 |
| C 026 | 1 | 21-80396A49 | CAPACITOR | .1UF-20-100 |
| C 027 | 1 | 21-80396A49 | CAPACITOR | .1UF-20-100 |
| C 028 | 1 | 21D84494B03 | CAPACITOR | 80PF-5-500 |
| C 029 | 1 | 21D84494B16 | CAPACITOR | 330PF-5-500 |
| C 030 | 1 | 21D84494B24 | CAPACITOR | 39PF-5-500 |
| C 031 | 1 | 08D84326A48 | CAPACITOR | .022UF-1-50 |
| C 032 | 1 | 08D84326A48 | CAPACITOR | .022UF-1-50 |
| C 033 | 1 | 21-80396A49 | CAPACITOR | .1UF-20-100 |
| C 034 | 1 | 21-80396A49 | CAPACITOR | .1UF-20-100 |
| C 035 | 1 | 21-80396A49 | CAPACITOR | .1UF-20-100 |
| C 036 | 1 | 21-80396A49 | CAPACITOR | .1UF-20-100 |
| C 037 | 1 | 23-80396A40 | CAPACITOR | 10UF-25V |
| C 038 | 1 | 21-80396A49 | CAPACITOR | .1UF-20-100 |
| C 039 | 1 | 21D84494B07 | CAPACITOR | 150PF-5-500 |
| C 040 | 1 | 21D84494B07 | CAPACITOR | 150PF-5-500 |
| C 041 | 1 | 21-80396A49 | CAPACITOR | .1UF-20-100 |
| C 042 | 1 | 21-80396A49 | CAPACITOR | .1UF-20-100 |
| C 043 | 1 | 23D83441B15 | CAPACITOR | 1.0UF-20-35 |
| C 044 | 1 | 23D83441B15 | CAPACITOR | 1.0UF-20-35 |
| C 045 | 1 | 08D84326A48 | CAPACITOR | .022UF-1-50 |
| C 047 | 1 | 08D82096J08 | CAPACITOR | .022UF-10-250 |
| C 048 | 1 | 23-80396A40 | CAPACITOR | 10UF-25V |
| C 049 | 1 | 21D84494B30 | CAPACITOR | 34PF-5-500 |
| C 050 | 1 | 23-80396A40 | CAPACITOR | 10UF-25V |
| C 051 | 1 | 23-80396A40 | CAPACITOR | 10UF-25V |
| C 052 | 1 | 21-80396A49 | CAPACITOR | .1UF-20-100 |
| C 053 | 1 | 21-80396A51 | CAPACITOR | 1000PF-10-100 |
| C 054 | 1 | 23-80396A40 | CAPACITOR | 10UF-25V |
| C 055 | 1 | 21-80396A49 | CAPACITOR | .1UF-20-100 |
| C 056 | 1 | 21C82372C10 | CAPACITOR | .05UF-20-25 |
| C 057 | 1 | CM06FD102J03 | CAPACITOR | 1000PF-5-500 |
| C 059 | 1 | 21D82428B19 | CAPACITOR | .01UF-20-500 |
| C 060 | 1 | 21-850118 | CAPACITOR | 100PF-5-500 |
| CR001 | 1 | 48-80345A80 | DIODE,ZENER | 2.4V-5-.5 |
| CR002 | 1 | 48-80345A81 | DIODE,ZENER | 9V |
| CR004 | 1 | 48-80345A81 | DIODE,ZENER | 9V |
| CR005 | 1 | 48-84463K02 | DIODE | |
| CR006 | 1 | 48-84463K02 | DIODE | |
| CR007 | 1 | 48-84463K02 | DIODE | |
| CR008 | 1 | 48-84463K02 | DIODE | |
| CR009 | 1 | 48-82256C11 | DIODE,ZENER | 10V-5-.4 |
| L 001 | 1 | 24-14198A55 | COIL | 470UH |
| L 002 | 1 | 24-14198A55 | COIL | 470UH |
| L 003 | 1 | 24-80369A31 | COIL | 22UH |
| Q 001 | 1 | 48-80368A92 | TRANSISTOR | MPS6519 SCREENED |
| Q 002 | 1 | 48-80368A91 | TRANSISTOR | MPS6520 SCREENED |
| Q 003 | 1 | 48-80368A91 | TRANSISTOR | MPS6520 SCREENED |
| Q 004 | 1 | 48-80368A92 | TRANSISTOR | MPS6519 SCREENED |
| Q 005 | 1 | 48-80368A91 | TRANSISTOR | MPS6520 SCREENED |
| R 001 | 1 | 6S124A73 | RESISTOR | 10K-5-1/4 |
| R 002 | 1 | 6S124A73 | RESISTOR | 10K-5-1/4 |
| R 003 | 1 | 6S124B06 | RESISTOR | 220K-5-1/4 |
| R 004 | 1 | 6S124A73 | RESISTOR | 10K-5-1/4 |
| R 005 | 1 | 6S124A29 | RESISTOR | 150-5-1/4 |
| R 006 | 1 | 06-10621B94 | RESISTOR | 1000-1-1/8 |
| R 007 | 1 | 06-10621C23 | RESISTOR | 1960-1-1/8 |
| R 008 | 1 | 06-10621C15 | RESISTOR | 1620-1-1/8 |
| R 009 | 1 | 06-10621B94 | RESISTOR | 1000-1-1/8 |
| R 010 | 1 | 6S124B22 | RESISTOR | 1M-5-1/4 |
| R 011 | 1 | 6S124A97 | RESISTOR | 100K-5-1/4 |
| R 013 | 1 | 6S124A67 | RESISTOR | 5.6K-5-1/4 |
| R 014 | 1 | 6S124A83 | RESISTOR | 27K-5-1/4 |
| R 015 | 1 | 6S124A77 | RESISTOR | 15K-5-1/4 |
| R 016 | 1 | 06-10621D88 | RESISTOR | 100K-1-1/8 |
| R 017 | 1 | 06-10621D56 | RESISTOR | 46.4K-1-1/8 |
| R 018 | 1 | 06-10621C95 | RESISTOR | 11K-1-1/8 |
| R 019 | 1 | 06-10621C43 | RESISTOR | 3160-1-1/8 |
| R 023 | 1 | 6S124A73 | RESISTOR | 10K-5-1/4 |
| R 024 | 1 | 6S124A49 | RESISTOR | 1K-5-1/4 |
| R 025 | 1 | 6S124B18 | RESISTOR | 680K-5-1/4 |
| R 026 | 1 | 6S124A97 | RESISTOR | 100K-5-1/4 |
| R 027 | 1 | 6S124A97 | RESISTOR | 100K-5-1/4 |

Figure 12-3. Audio Synthesizer A6 (RTC-4011B) Parts Location Diagram (Sheet 2 of 3)

| Find No. | Qty. Req. | Part No. | Nomenclature | Part Value |
|---|---|---|---|---|
| R 028 | 1 | 6S124A70 | RESISTOR | 7.5K-5-1/4 |
| R 029 | 1 | 6S124A69 | RESISTOR | 6.8K-5-1/4 |
| R 030 | 1 | 06-10621D48 | RESISTOR | 38.3K-1-1/8 |
| R 031 | 1 | 06-10621B50 | RESISTOR | 348-1-1/8 |
| R 032 | 1 | 06-10621E05 | RESISTOR | 147K-1-1/8 |
| R 033 | 1 | 6S124A62 | RESISTOR | 3.6K-5-1/4 |
| R 034 | 1 | 6S124A53 | RESISTOR | 1.5K-5-1/4 |
| R 035 | 1 | 6S124A65 | RESISTOR | 4.7K-5-1/4 |
| R 036 | 1 | 6S124A69 | RESISTOR | 6.8K-5-1/4 |
| R 037 | 1 | 6S124A53 | RESISTOR | 1500-5-1/4 |
| R 038 | 1 | 6S124A43 | RESISTOR | 560-5-1/4 |
| R 039 | 1 | 6S124A99 | RESISTOR | 120K-5-1/4 |
| R 040 | 1 | 6S124A73 | RESISTOR | 10K-5-1/4 |
| R 041 | 1 | 6S124A91 | RESISTOR | 56K-5-1/4 |
| R 042 | 1 | 6S124A66 | RESISTOR | 5.1K-5-1/4 |
| R 043 | 1 | 6S124A91 | RESISTOR | 56K-5-1/4 |
| R 045 | 1 | 6S124A97 | RESISTOR | 100K-5-1/4 |
| R 046 | 1 | 6S124A25 | RESISTOR | 100-5-1/4 |
| R 047 | 1 | 6S124A25 | RESISTOR | 100-5-1/4 |
| R 048 | 1 | 6S124A73 | RESISTOR | 10K-5-1/4 |
| R 049 | 1 | 6S124A73 | RESISTOR | 10K-5-1/4 |
| R 050 | 1 | 6S124A25 | RESISTOR | 100-5-1/4 |
| R 051 | 1 | 6S124A25 | RESISTOR | 100-5-1/4 |
| R 052 | 1 | 6S124A29 | RESISTOR | 150-5-1/4 |
| R 053 | 1 | 6S124A73 | RESISTOR | 10K-5-1/4 |
| R 054 | 1 | 6S124A73 | RESISTOR | 10K-5-1/4 |
| R 055 | 1 | 6S124A25 | RESISTOR | 100-5-1/4 |
| R 056 | 1 | 6S124A25 | RESISTOR | 100-5-1/4 |
| R 057 | 1 | 6S124A49 | RESISTOR | 1K-5-1/4 |
| R 058 | 1 | 6S124A66 | RESISTOR | 5.1K-5-1/4 |
| R 059 | 1 | 6S124A73 | RESISTOR | 10K-5-1/4 |
| R 060 | 1 | 6S124A73 | RESISTOR | 10K-5-1/4 |
| R 061 | 1 | 6S124B38 | RESISTOR | 4.7M-5-1/4 |
| R 063 | 1 | 6S124A67 | RESISTOR | 5.6K-5-1/4 |
| R 064 | 1 | 6S124A67 | RESISTOR | 5.6K-5-1/4 |
| R 065 | 1 | 6S124A77 | RESISTOR | 15K-5-1/4 |
| R 066 | 1 | 6S124A49 | RESISTOR | 1000-5-1/4 |
| R 067 | 1 | 6S185A33 | RESISTOR | 220-5-1/8 |
| R 068 | 1 | 6S124A46 | RESISTOR | 750-5-1/4 |
| TP001 | 1 | 09-80331A88 | JACK,TIP | WHT |
| TP002 | 1 | 09-80331A88 | JACK,TIP | WHT |
| TP003 | 1 | 09-80331A88 | JACK,TIP | WHT |
| TP004 | 1 | 09-80331A88 | JACK,TIP | WHT |
| TP005 | 1 | 09-80331A88 | JACK,TIP | WHT |
| TP006 | 1 | 09-80331A88 | JACK,TIP | WHT |
| TP007 | 1 | 09-80331A88 | JACK,TIP | WHT |
| TP008 | 1 | 09-80331A88 | JACK,TIP | WHT |
| TP009 | 1 | 09-80331A88 | JACK,TIP | WHT |
| U 001 | 1 | 51-80345A04 | INTEGRATED CIRCUIT | CA3240E SCREENED |
| U 002 | 1 | 51-80345A04 | INTEGRATED CIRCUIT | CA3240E SCREENED |
| U 003 | 1 | 51-P07936V004 | INTEGRATED CIRCUIT | MC1408P8DS SCREENE |
| U 004 | 1 | 51-80368A46 | INTEGRATED CIRCUIT | MC14175BCP SCREENE |
| U 005 | 1 | 51-80368A46 | INTEGRATED CIRCUIT | MC14175BCP SCREENE |
| U 006 | 1 | 51-80368A26 | INTEGRATED CIRCUIT | SN74LS90NS SCREENE |
| U 007 | 1 | 51-80368A11 | INTEGRATED CIRCUIT | SN74LS04NS SCREENE |
| U 008 | 1 | 51-80396A16 | INTEGRATED CIRCUIT | LM324N SCREENED |
| U 011 | 1 | 51-80396A03 | INTEGRATED CIRCUIT | 2K X 8 EPROM |
| U 014 | 1 | 51-80368A46 | INTEGRATED CIRCUIT | MC14175BCP SCREENE |
| U 015 | 1 | 51-80368A46 | INTEGRATED CIRCUIT | MC14175BCP SCREENE |
| U 016 | 1 | 51-80368A46 | INTEGRATED CIRCUIT | MC14175BCP SCREENE |
| U 017 | 1 | 51-80368A46 | INTEGRATED CIRCUIT | MC14175BCP SCREENE |
| U 018 | 1 | 51-80368A46 | INTEGRATED CIRCUIT | MC14175BCP SCREENE |
| U 019 | 1 | 51-82884L48 | INTEGRATED CIRCUIT | MC14066BCP SCREENE |
| U 020 | 1 | 51-80368A30 | INTEGRATED CIRCUIT | MC14006BCP SCREENE |
| U 021 | 1 | 51-80396A16 | INTEGRATED CIRCUIT | LM324N SCREENED |
| U 022 | 1 | 51-80396A16 | INTEGRATED CIRCUIT | LM324N SCREENED |
| U 023 | 1 | 51-82884L48 | INTEGRATED CIRCUIT | MC14066BCP SCREENE |
| U 024 | 1 | 51-82884L48 | INTEGRATED CIRCUIT | MC14066BCP SCREENE |
| U 025 | 1 | 51-80396A16 | INTEGRATED CIRCUIT | LM324N SCREENED |
| U 026 | 1 | 51-80368A31 | INTEGRATED CIRCUIT | MC14008BCP SCREENE |
| U 027 | 1 | 51-80368A31 | INTEGRATED CIRCUIT | MC14008BCP SCREENE |
| U 028 | 1 | 51-80368A31 | INTEGRATED CIRCUIT | MC14008BCP SCREENE |
| U 029 | 1 | 51-80368A31 | INTEGRATED CIRCUIT | MC14008BCP SCREENE |
| U 030 | 1 | 51-80368A31 | INTEGRATED CIRCUIT | MC14008BCP SCREENE |
| U 031 | 1 | 51-80345A01 | INTEGRATED CIRCUIT | CA3140E SCREENED |
| U 032 | 1 | 51-80368A32 | INTEGRATED CIRCUIT | MC14011BCP SCREENE |
| U 033 | 1 | 51-80368A30 | INTEGRATED CIRCUIT | MC14006BCP SCREENE |
| U 034 | 1 | 51-80368A32 | INTEGRATED CIRCUIT | MC14011BCP SCREENE |
| U 035 | 1 | 51-80345A16 | INTEGRATED CIRCUIT | MC14028BCP SCREENE |
| U 036 | 1 | 51-80368A32 | INTEGRATED CIRCUIT | MC14011BCP SCREENE |
| U 037 | 1 | 51-80368A58 | INTEGRATED CIRCUIT | MC14042B SCREENED |
| U 038 | 1 | 51-80345A04 | INTEGRATED CIRCUIT | CA3240E SCREENED |
| U 039 | 1 | 51-80368A58 | INTEGRATED CIRCUIT | MC14042B SCREENED |
| U 040 | 1 | 51-80368A58 | INTEGRATED CIRCUIT | MC14042B SCREENED |
| U 041 | 1 | 51-80368A58 | INTEGRATED CIRCUIT | MC14042B SCREENED |
| U 042 | 1 | 51-80368A58 | INTEGRATED CIRCUIT | MC14042B SCREENED |
| U 043 | 1 | 51-80368A58 | INTEGRATED CIRCUIT | MC14042B SCREENED |
| U 044 | 1 | 51-80368A58 | INTEGRATED CIRCUIT | MC14042B SCREENED |
| U 045 | 1 | 1-807148B4 | INTEGRATED CIRCUIT | |
| U 046 | 1 | 51-80345A04 | INTEGRATED CIRCUIT | CA3240E SCREENED |
| U 047 | 1 | 51-80345A04 | INTEGRATED CIRCUIT | CA3240E SCREENED |
| Y 001 | 1 | 48-80346A07 | CRYSTAL | 1.048576MHZHHH |

Figure 12-3. Audio Synthesizer A6 (RTC-4011B) Parts Location Diagram (Sheet 3 of 3)

# SECTION 13
# PROCESSOR I/O MODULE (A7)

**13-1. General.** Frequency Counter and DVM functions with their processor interface as well as the processor interface for the two system control buses are contained on this module. Additionally, circuitry to complete the 10.245 MHz phase locked loop, and to zero beat the incoming carrier are also on this board. A block diagram of the processor I/O module is shown in figure 13-1 with its schematic shown in figure 13.2.

**13-2. 10.245 MHz Phase Locked Loop.** Only part of the circuitry for the second local oscillator loop is contained on this module. The 10.245 MHz VCO and the loop filter are on the receiver module. A sample of the 10.245 MHz second local oscillator is mixed with the SYNTH 10 MHz signal. A divide by forty nine following the mixer divides the 245 kHz signal from the mixer to 5 kHz. A phase comparison between the 5 kHz from the divider and the SYNTH 5 kHz signal results in the 10.245 MHz VCO TV signal. The VCO TV signal is an error signal which is filtered by the loop filter on the receiver to correct the VCO frequency and maintain phase lock.

**13-3. System Control Bus Interface.** Interface between the processor buses and the system is through Peripheral Interface Adapters (PIA). The PIA is a single integrated circuit that provides 18 input/output latches which may either be read from or written into by the processor. Two additional inputs on the PIA provide for processor interrupt capability. The two system control buses utilize a single PIA.

13-4. Each system control bus consists of eight lines split into four data lines and four address lines. The address lines define the particular latch into which the data is to be stored, or the buffer from which data is to be obtained. One additional address line, the bus enable line, is required to enable the address decoding circuitry. Thus each control bus can have as many latches at one address as there are bus enable lines. The system utilizes one RF bus enable and two AF bus enables for a total control bus capability of 192 bits. The second bus enable for the AF control bus is on the processor card.

13-5. A dedicated timer is included on the A7 module to provide interval timing to the processor for tone sequences and other functions. The processor initiates the timing with a control word on the Data Lines and an enable pulse on the E line. The timer interrupts the processor when the interval is complete. The timer reference frequency is SYNTH 1 kHz a 1 kHz square wave locked to the system reference frequency.

**13-6. A/D Converter.** The A/D converter converts positive DC voltages between 0 and 1023 millivolts into a 10 bit digital word for input to the processor via the DVM/FREQ COUNTER PIA. Polarity information for a DC voltage at the EXT DVM TO A/D input is detected by the SIGN DETECTOR circuit and is input to the processor as a 1 bit word along with the voltage reading. A conversion is initiated by the processor with a pulse on the START line. The A/D converter signals the processor that the conversion is complete by a pulse on the END line. The processor in turn enables the output drivers on the A/D, sets the DVM/CNTR BUFFER to the DVM mode, and inputs the 10 bit word and the sign bit.

**13-7. External DVM.** In the external DVM mode, voltages applied to the input jack on the front panel are ranged by processor control over four decades in the A12 (front panel interface)module. The signal is passed directly through the A3 (Scope/DVM Control) module to the EXT DVM TO A/D input on the A7 module. The resulting dynamic voltage range at the EXT DVM TO A/D input is 0 to 1 VRMS. There the signal is amplified by a voltage gain of 3.5 and applied to the RMS to DC converter. The resulting output is applied to an attenuator with a voltage gain of 1/3.5. The amplifier and attenuator allow the RMS to DC converter to work with larger signal levels which in turn provides a net increase in conversion speed. The INT/EXT DVM SELECTOR switches the output of the attenuator to the A/D converter for conversion as in 13-6.

13-8. In the DC mode inputs are low pass filtered in the A12 (front panel interface) module before entering the A7 module. The RMS to DC converter reads true RMS, therefore the output for a DC input is the positive square root of the input squared i.e. the absolute value of the input voltage.

13-9. In the AC mode inputs are capacitor coupled in the A12 module. Therefore only the RMS voltage of the AC component is measured.

**13-10. Internal DVM.** Internal DVM voltages are positive mode voltages internal to the R2001 that are proportional to certain parameters in the system i.e. (power readings, Battery voltage, modulation peaks, etc.). These signals are ranged over two decades to a 0 to 1 VDC range on the A3 module and routed to the INT DVM TO A/D input on the A7 module. The processor makes an internal measurement by selecting the internal path at the INT/EXT DVM SELECTOR which routes the signal directly to the A/D converter for conversion as in paragraph 13-6.

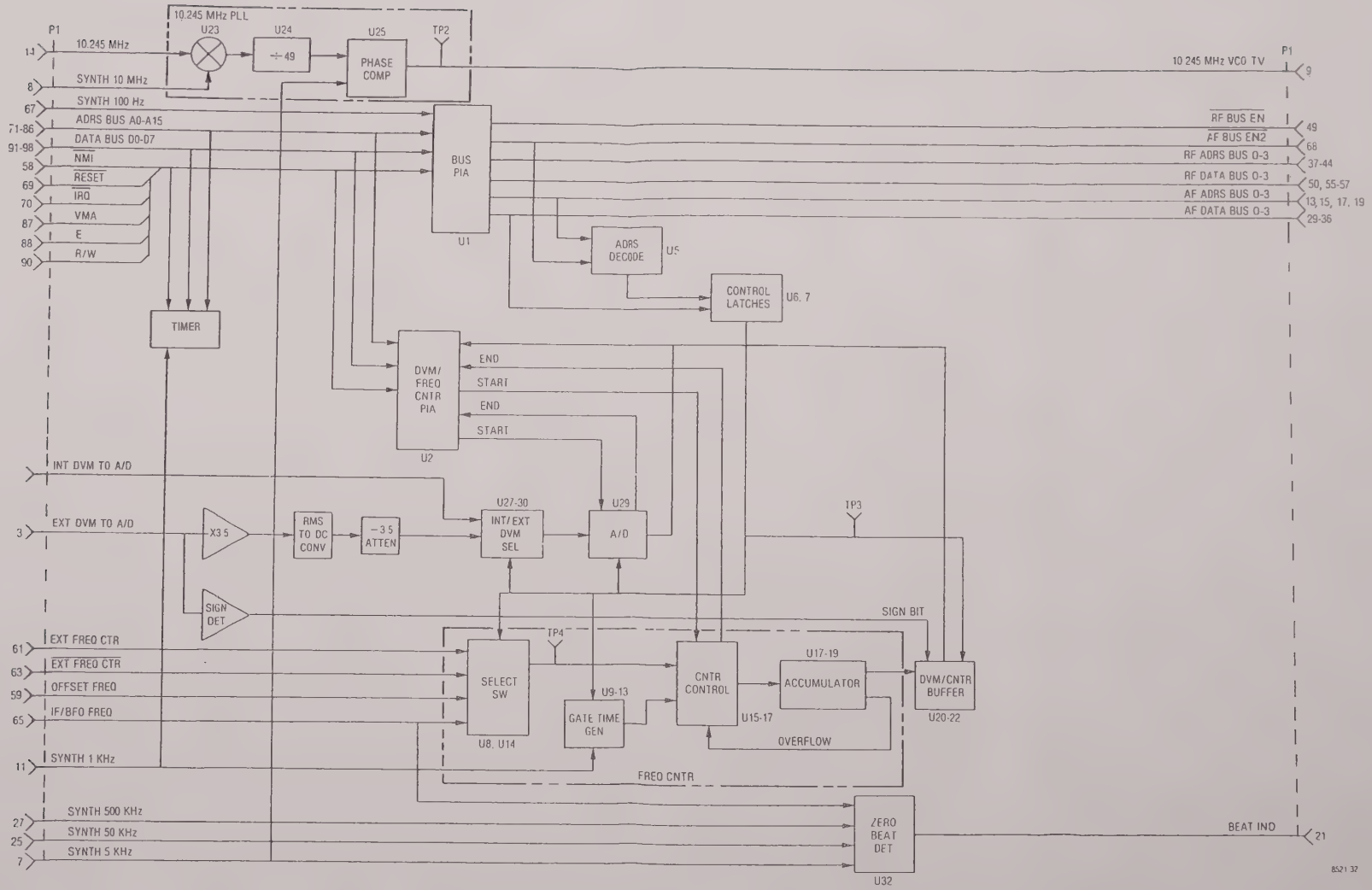
**13-11. Distortion Reading.** In the distortion measurement mode the 1 kHz fundamental of the input is filtered out by a notch filter on the A3 module. The distortion products are routed to the EXT DVM TO A/D input of the A7 module for input to the processor. The input to the notch filter is rectified and averaged on the A3 module and then routed through the internal DVM circuitry for measurement.

**13-12. Frequency Counter.** Three possible signal sources are available to the frequency counter for frequency determination. For external inputs the EXT FREQ CTR line from the Front Panel Interface module provides the input. Determination of the duplex frequency is accomplished by measuring the frequency of the offset oscillator on the OFFSET FREQ line. Monitor frequency error is determined from the IF/BFO FREQ line by comparing that frequency to 455 kHz. The desired signal is selected to the counter control by the Select Switch under processor control.

13-14. The Counter Control circuitry responds to a START pulse from the processor to gate the output of the Select Switch to the Accumulator for a time period determined by the Gate Time Generator. When the gate time has ended, or if the accumulator overflows, the Counter Control signals the processor on the END line that the count is complete. The processor in turn disables the A/D output drivers, switches the DVM/CNTR Buffer to the counter mode, and inputs the 16-bit accumulator information.

13-15. Gate times from 0.001 sec to 10 sec are generated by the Gate Time Generator. The SYNTH 1 kHz signal is the reference input for the generator. Selection of the gate time is by processor control to give a five digit or 0.1 Hz resolution frequency display.

13-16. Zero Beat. A zero beat with the incoming carrier is obtained by successively mixing the 455 kHz IF/BFO FREQ with 500 kHz, and 5 kHz. The beat signal that results from the mixing drives the ground return circuit for the signal presence indicator.




gure 13-1. Processor I/O A7
Block Diagram

13-17. Module Control. Control of this module is from the processor on the AF control bus. A four bit address (AF ADRS BUS 0-3) is decoded by the Address Decode circuitry to determine which Control Latch the control data is to be stored. The four data bits (AF DATA BUS 0-3) are then stored in the selected Control-Latch by a pulse on the AF BUS EN 2 signal line.

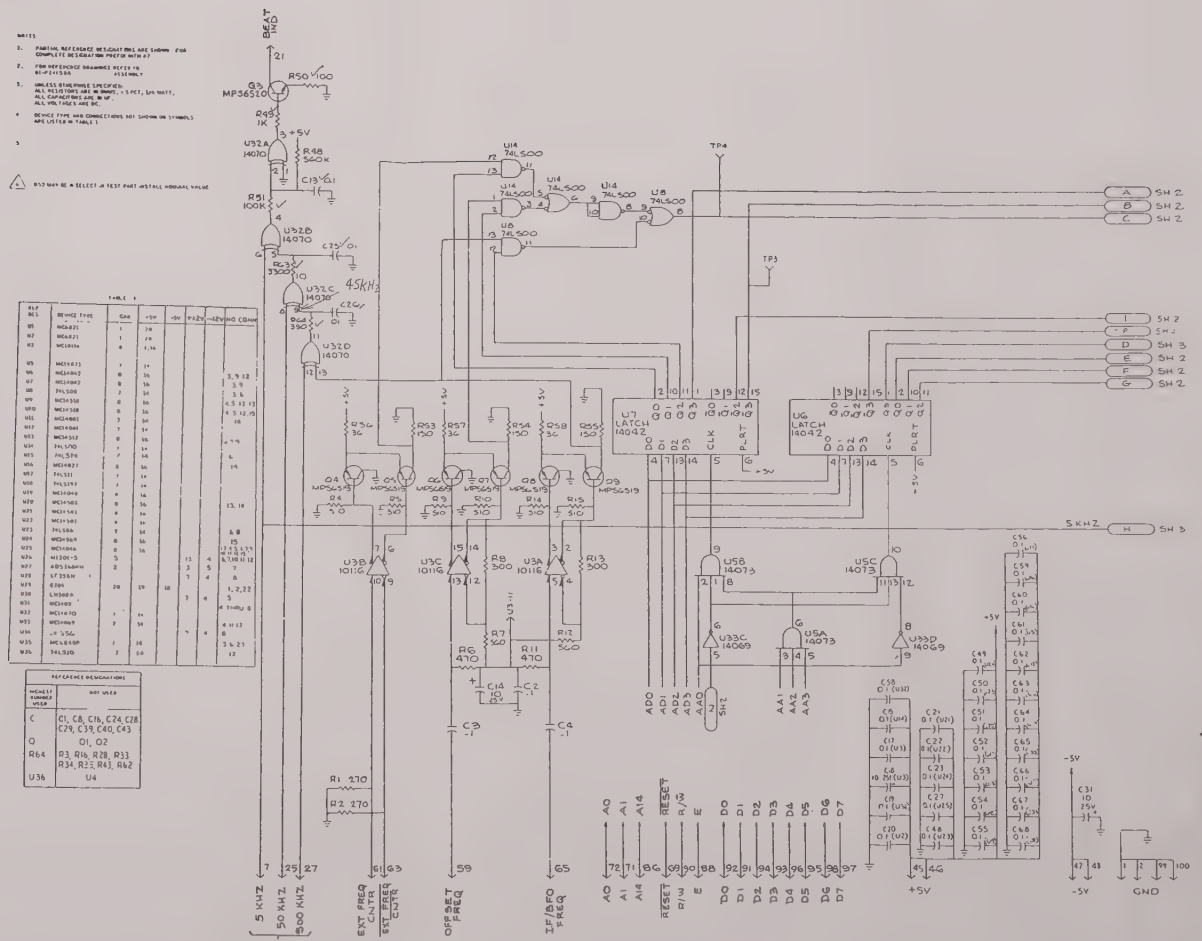



Figure 13-2. Processor I/O A7 Schematic Diagram (Sheet 1 of 3)

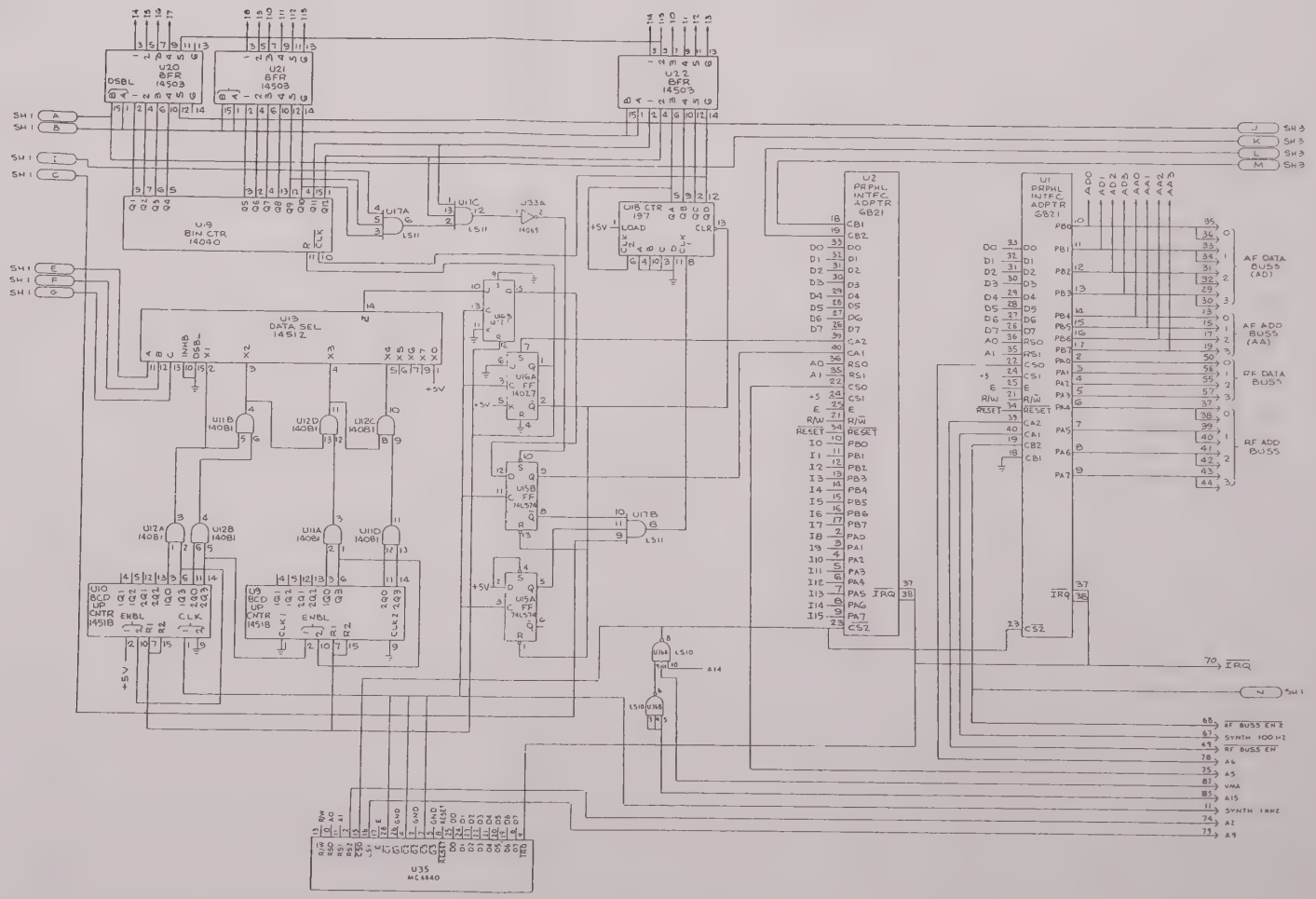


Figure 13-2. Processor I/O A7 Schematic Diagram (Sheet 2 of 3)

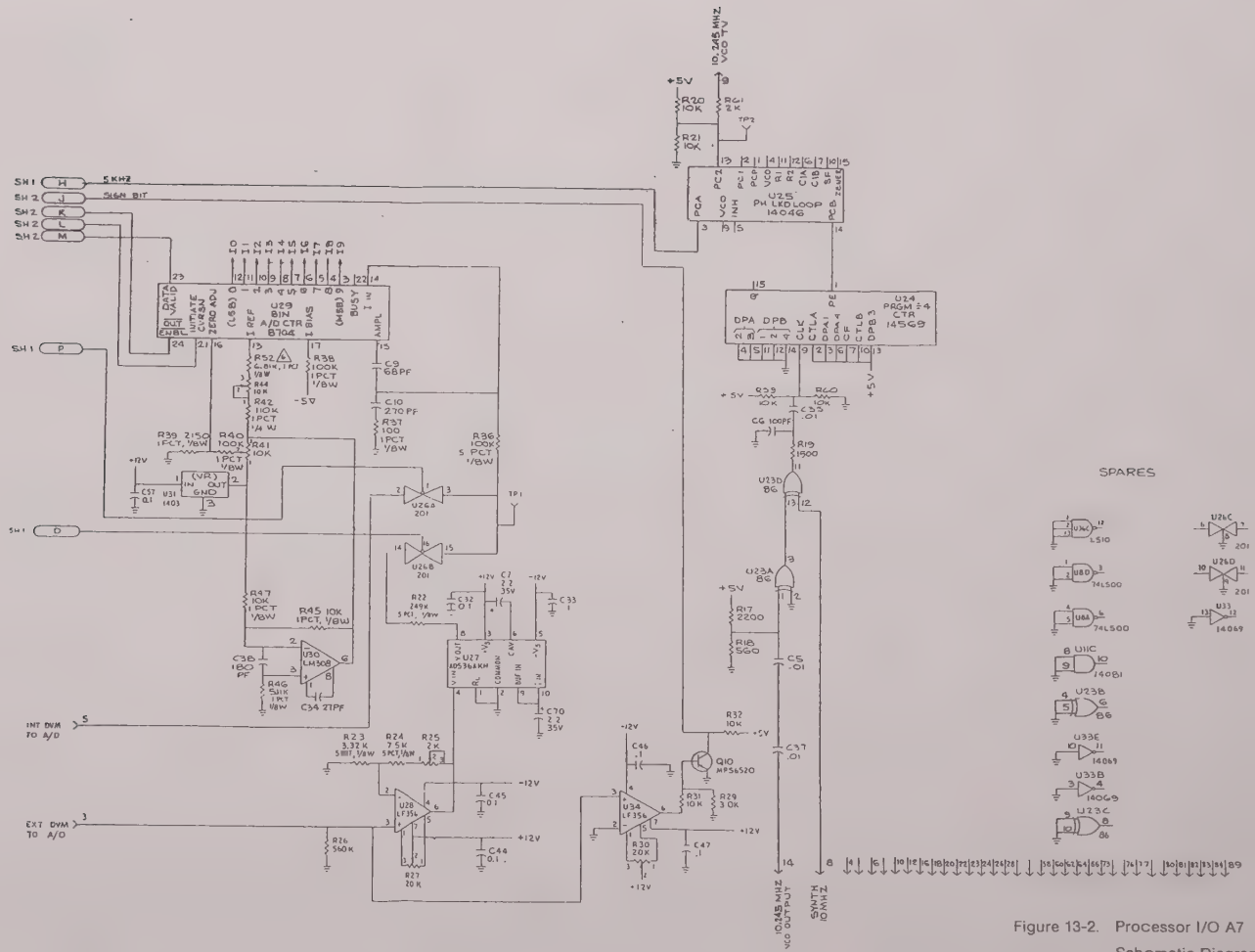



Figure 13-2. Processor I/O A7 Schematic Diagram (Sheet 3 of 3)

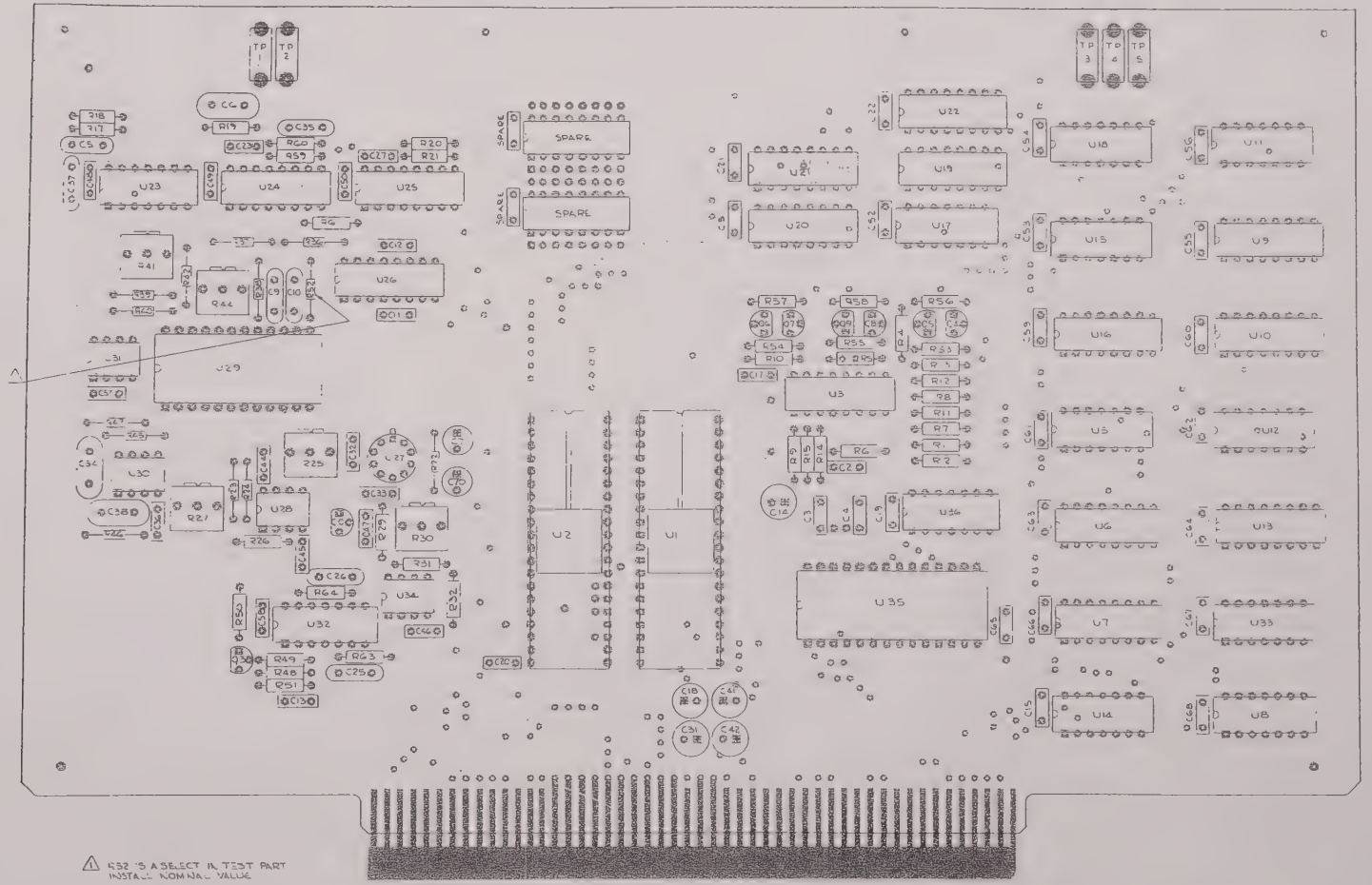



Figure 13-3. Processor I/O A7 (RTC-4025A)
Parts Location Diagram
(Sheet 1 of 2)

| Find No. | Qty. Req. | Part No. | Nomenclature | Part Value |
|---|---|---|---|---|
| | | RTC-4025A | PROCESSOR I/O | |
| 001 | 1 | 84-P24172A001 | PWB,PROCESSOR I/O | |
| 003 | AR | SN63WRP3 | SOLDER | |
| 004 | AR | 11-14167A01 | INK | BLACK |
| 005 | 1 | 07-80335A53 | BRACKET,PWB MTG | |
| 006 | 4 | MS20470AD4-5 | RIVET | 1/8X.312 |
| 007 | 2 | 5C84500B03 | EYELET | |
| 008 | 2 | 42C84284B01 | RETAINER | |
| 009 | 2 | 03-139581 | SCREW,PH | 4-40X.312 |
| C 002 | 1 | 21-80369A82 | CAPACITOR | .1UF-20-100 |
| C 003 | 1 | 21-80369A82 | CAPACITOR | .1UF-20-100 |
| C 004 | 1 | 21-80369A82 | CAPACITOR | .1UF-20-100 |
| C 005 | 1 | 21-80396A52 | CAPACITOR | .01UF-20+80-200 |
| C 006 | 1 | 21D84494B04 | CAPACITOR | 100PF-5-500 |
| C 007 | 1 | 23-80396A34 | CAPACITOR | 2.2UF-20-35 |
| C 009 | 1 | 21D84494B34 | CAPACITOR | 68PF-5-500 |
| C 010 | 1 | 21D82187B04 | CAPACITOR | 270PF-10-500 |
| C 011 | 1 | 21-80369A82 | CAPACITOR | .1UF-20-100 |
| C 012 | 1 | 21-80369A82 | CAPACITOR | .1UF-20-100 |
| C 013 | 1 | 21-80369A82 | CAPACITOR | .1UF-20-100 |
| C 014 | 1 | 23-80396A40 | CAPACITOR | 10UF-25V |
| C 015 | 1 | 21-80369A82 | CAPACITOR | .1UF-20-100 |
| C 017 | 1 | 21-80369A82 | CAPACITOR | .1UF-20-100 |
| C 018 | 1 | 23-80396A40 | CAPACITOR | 10UF-25V |
| C 019 | 1 | 21-80369A82 | CAPACITOR | .1UF-20-100 |
| C 020 | 1 | 21-80369A82 | CAPACITOR | .1UF-20-100 |
| C 021 | 1 | 21-80369A82 | CAPACITOR | .1UF-20-100 |
| C 022 | 1 | 21-80369A82 | CAPACITOR | .1UF-20-100 |
| C 023 | 1 | 21-80369A82 | CAPACITOR | .1UF-20-100 |
| C 025 | 1 | 21-80396A52 | CAPACITOR | .01UF-20+80-200 |
| C 026 | 1 | 21-80396A52 | CAPACITOR | .01UF-20+80-200 |
| C 027 | 1 | 21-80369A82 | CAPACITOR | .1UF-20-100 |
| C 031 | 1 | 23-80396A40 | CAPACITOR | 10UF-25V |
| C 032 | 1 | 21-80369A82 | CAPACITOR | .1UF-20-100 |
| C 033 | 1 | 21-80369A82 | CAPACITOR | .1UF-20-100 |
| C 034 | 1 | 21D84494B42 | CAPACITOR | 27PF-5-500 |
| C 035 | 1 | 21-80396A52 | CAPACITOR | .01UF-20+80-200 |
| C 036 | 1 | 21-80369A82 | CAPACITOR | .1UF-20-100 |
| C 037 | 1 | 21-80396A52 | CAPACITOR | .01UF-20+80-200 |
| C 038 | 1 | 21D84494B46 | CAPACITOR | 180PF-3-500 |
| C 041 | 1 | 23-80396A40 | CAPACITOR | 10UF-25V |
| C 042 | 1 | 23-80396A40 | CAPACITOR | 10UF-25V |
| C 044 | 1 | 21-80369A82 | CAPACITOR | .1UF-20-100 |
| C 045 | 1 | 21-80369A82 | CAPACITOR | .1UF-20-100 |
| C 046 | 1 | 21-80369A82 | CAPACITOR | .1UF-20-100 |
| C 047 | 1 | 21-80369A82 | CAPACITOR | .1UF-20-100 |
| C 048 | 1 | 21-80369A82 | CAPACITOR | .1UF-20-100 |
| C 049 | 1 | 21-80369A82 | CAPACITOR | .1UF-20-100 |
| C 050 | 1 | 21-80369A82 | CAPACITOR | .1UF-20-100 |
| C 051 | 1 | 21-80369A82 | CAPACITOR | .1UF-20-100 |
| C 052 | 1 | 21-80369A82 | CAPACITOR | .1UF-20-100 |
| C 053 | 1 | 21-80369A82 | CAPACITOR | .1UF-20-100 |
| C 054 | 1 | 21-80369A82 | CAPACITOR | .1UF-20-100 |
| C 055 | 1 | 21-80369A82 | CAPACITOR | .1UF-20-100 |
| C 056 | 1 | 21-80369A82 | CAPACITOR | 1UF-20-100 |
| C 057 | 1 | 21-80369A82 | CAPACITOR | .1UF-20-100 |
| C 058 | 1 | 21-80369A82 | CAPACITOR | 1UF-20-100 |
| C 059 | 1 | 21-80369A82 | CAPACITOR | .1UF-20-100 |
| C 060 | 1 | 21-80369A82 | CAPACITOR | 1UF-20-100 |
| C 061 | 1 | 21-80369A82 | CAPACITOR | .1UF-20-100 |
| C 062 | 1 | 21-80369A82 | CAPACITOR | .1UF-20-100 |
| C 063 | 1 | 21-80369A82 | CAPACITOR | .1UF-20-100 |
| C 064 | 1 | 21-80369A82 | CAPACITOR | 1UF-20-100 |
| C 065 | 1 | 21-80369A82 | CAPACITOR | .1UF-20-100 |
| C 066 | 1 | 21-80369A82 | CAPACITOR | .1UF-20-100 |
| C 067 | 1 | 21-80369A82 | CAPACITOR | .1UF-20-100 |
| C 068 | 1 | 21-80369A82 | CAPACITOR | .1UF-20-100 |
| C 070 | 1 | 23-80396A34 | CAPACITOR | 2.2UF-20-35 |
| Q 003 | 1 | 48-80368A91 | TRANSISTOR | MPS6520 SCREENED |
| Q 004 | 1 | 48-80368A92 | TRANSISTOR | MPS6519 SCREENED |
| Q 005 | 1 | 48-80368A92 | TRANSISTOR | MPS6519 SCREENED |
| Q 006 | 1 | 48-80368A92 | TRANSISTOR | MPS6519 SCREENED |
| Q 007 | 1 | 48-80368A92 | TRANSISTOR | MPS6519 SCREENED |
| Q 008 | 1 | 48-80368A92 | TRANSISTOR | MPS6519 SCREENED |
| Q 009 | 1 | 48-80368A92 | TRANSISTOR | MPS6519 SCREENED |
| Q 010 | 1 | 48-80368A91 | TRANSISTOR | MPS6520 SCREENED |
| R 001 | 1 | 6S124A35 | RESISTOR | 270-5-1/4 |
| R 002 | 1 | 6S124A35 | RESISTOR | 270-5-1/4 |
| R 004 | 1 | 6S124A42 | RESISTOR | 510-5-1/4 |
| R 005 | 1 | 6S124A42 | RESISTOR | 510-5-1/4 |
| R 006 | 1 | 6S124A41 | RESISTOR | 470-5-1/4 |
| R 007 | 1 | 6S124A43 | RESISTOR | 560-5-1/4 |
| R 008 | 1 | 6S124A35 | RESISTOR | 300-5-1/4 |
| R 009 | 1 | 6S124A42 | RESISTOR | 510-5-1/4 |
| R 010 | 1 | 6S124A42 | RESISTOR | 510-5-1/4 |
| R 011 | 1 | 6S124A41 | RESISTOR | 470-5-1/4 |
| R 012 | 1 | 6S124A43 | RESISTOR | 560-5-1/4 |
| R 013 | 1 | 6S124A36 | RESISTOR | 300-5-1/4 |
| R 014 | 1 | 6S124A42 | RESISTOR | 510-5-1/4 |
| R 015 | 1 | 6S124A42 | RESISTOR | 510-5-1/4 |
| R 017 | 1 | 6S124A57 | RESISTOR | 2.2K-5-1/4 |
| R 018 | 1 | 6S124A43 | RESISTOR | 560-5-1/4 |
| R 019 | 1 | 6S124A53 | RESISTOR | 1.5K-5-1/4 |
| R 020 | 1 | 6S124A73 | RESISTOR | 10K-5-1/4 |
| R 021 | 1 | 6S124A73 | RESISTOR | 10K-5-1/4 |
| R 022 | 1 | 06-80395A66 | RESISTOR | 249K-.5-1/8 |
| R 023 | 1 | 06-80396A67 | RESISTOR | 3.32K-.5-1/8 |
| R 024 | 1 | 06-80396A69 | RESISTOR | 7.5K-.5-1/8 |
| R 025 | 1 | 18D83452F01 | RESISTOR,VARIABLE | 2K |
| R 026 | 1 | 6S124B16 | RESISTOR | 560K-5-1/4 |
| R 027 | 1 | 18D83452F15 | RESISTOR,VARIABLE | 20K |
| R 029 | 1 | 6S124A60 | RESISTOR | 3.0K-5-1/4 |
| R 030 | 1 | 18D83452F15 | RESISTOR,VARIABLE | 20K |
| R 031 | 1 | 6S124A73 | RESISTOR | 10K-5-1/4 |
| R 032 | 1 | 6S124A73 | RESISTOR | 10K-5-1/4 |
| R 036 | 1 | 06-80396A59 | RESISTOR | 100K-.5-1/8 |
| R 037 | 1 | 06-10621A97 | RESISTOR | 100-1-1/8 |
| R 038 | 1 | 06-10621D88 | RESISTOR | 100K-1-1/8 |
| R 039 | 1 | 06-10621C27 | RESISTOR | 2150-1-1/8 |
| R 040 | 1 | 06-10621D88 | RESISTOR | 100K-1-1/8 |
| R 041 | 1 | 18D83452F13 | RESISTOR,VARIABLE | 10K |
| R 042 | 1 | 06D84444A75 | RESISTOR | 110K-1-1/4 |
| R 044 | 1 | 18D83452F13 | RESISTOR,VARIABLE | 10K |
| R 045 | 1 | 06-10621C91 | RESISTOR | 10K-1-1/8 |
| R 046 | 1 | 06-10621C63 | RESISTOR | 5110-1-1/8 |
| R 047 | 1 | 06-10621C91 | RESISTOR | 10K-1-1/8 |
| R 048 | 1 | 6S124B16 | RESISTOR | 560K-5-1/4 |
| R 049 | 1 | 6S124A49 | RESISTOR | 1K-5-1/4 |
| R 050 | 1 | 6S124A25 | RESISTOR | 100-5-1/4 |
| R 051 | 1 | 6S124A97 | RESISTOR | 100K-5-1/4 |
| R 052 | 1 | 06-82526F55 | RESISTOR | 6810-1-1/8 NOMINAL |
| R 052 | AR | | WIRE,SOLID BUS | #26 |
| R 053 | 1 | 6S124A29 | RESISTOR | 150-5-1/4 |
| R 054 | 1 | 6S124A29 | RESISTOR | 150-5-1/4 |
| R 055 | 1 | 6S124A29 | RESISTOR | 150-5-1/4 |
| R 056 | 1 | 6S124A14 | RESISTOR | 36-5-1/4 |
| R 057 | 1 | 6S124A14 | RESISTOR | 36-5-1/4 |
| R 058 | 1 | 6S124A14 | RESISTOR | 36-5-1/4 |
| R 059 | 1 | 6S124A73 | RESISTOR | 10K-5-1/4 |
| R 060 | 1 | 6S124A73 | RESISTOR | 10K-5-1/4 |
| R 061 | 1 | 6S124A56 | RESISTOR | 2.0K-5-1/4 |
| R 063 | 1 | 6S124A61 | RESISTOR | 3.3K-5-1/4 |
| R 064 | 1 | 6S124A39 | RESISTOR | 390-5-1/4 |
| TP001 | 1 | 09-80331A88 | JACK,TIP | WHT |
| TP002 | 1 | 09-80331A88 | JACK,TIP | WHT |
| TP003 | 1 | 09-80331A88 | JACK,TIP | WHT |
| TP004 | 1 | 09-80331A88 | JACK,TIP | WHT |
| TP005 | 1 | 09-80331A88 | JACK,TIP | WHT |
| U 001 | 1 | 51-80368A72 | INTEGRATED CIRCUIT | MC6821P SCREENED |
| U 002 | 1 | 51-80368A72 | INTEGRATED CIRCUIT | MC6821P SCREENED |
| U 003 | 1 | 51-80323A60 | INTEGRATED CIRCUIT | MC10116P SCREENED |
| U 005 | 1 | 51-80368A44 | INTEGRATED CIRCUIT | MC14073BCP SCREENE |
| U 006 | 1 | 51-80368A58 | INTEGRATED CIRCUIT | MC14042B SCREENED |
| U 007 | 1 | 51-80368A58 | INTEGRATED CIRCUIT | MC14042B SCREENED |
| U 008 | 1 | 51-80368A09 | INTEGRATED CIRCUIT | SN74LS00NS SCREENE |
| U 009 | 1 | 51-80368A50 | INTEGRATED CIRCUIT | MC14518BCP SCREENE |
| U 010 | 1 | 51-80368A50 | INTEGRATED CIRCUIT | MC14518BCP SCREENE |
| U 011 | 1 | 51-80368A45 | INTEGRATED CIRCUIT | MC14081BCP SCREENE |
| U 012 | 1 | 51-80368A45 | INTEGRATED CIRCUIT | MC14081BCP SCREENE |
| U 013 | 1 | 51-80368A48 | INTEGRATED CIRCUIT | MC14512BCP SCREENE |
| U 014 | 1 | 51-80368A09 | INTEGRATED CIRCUIT | SN74LS00NS SCREENE |
| U 015 | 1 | 51-80368A24 | INTEGRATED CIRCUIT | SN74LS74NS SCREENE |
| U 016 | 1 | 51-80368A34 | INTEGRATED CIRCUIT | MC14027BCP SCREENE |
| U 017 | 1 | 51-80346A55 | INTEGRATED CIRCUIT | SN74LS11N SCREENED |
| U 018 | 1 | 51-80368A75 | INTEGRATED CIRCUIT | SN74LS197NS SCREEN |
| U 019 | 1 | 51-80368A35 | INTEGRATED CIRCUIT | MC14040BCP SCREENE |
| U 020 | 1 | 51-80368A47 | INTEGRATED CIRCUIT | MC14503BCP SCREENE |
| U 021 | 1 | 51-80368A47 | INTEGRATED CIRCUIT | MC14503BCP SCREENE |
| U 022 | 1 | 51-80368A47 | INTEGRATED CIRCUIT | MC14503BCP SCREENE |
| U 023 | 1 | 51-80368A25 | INTEGRATED CIRCUIT | SN74LS86NS SCREENE |
| U 024 | 1 | 51-80368A54 | INTEGRATED CIRCUIT | MC14569BCP SCREENE |
| U 025 | 1 | 51-80345A19 | INTEGRATED CIRCUIT | MC14046BCP SCREENE |
| U 026 | 1 | 51-80345A05 | INTEGRATED CIRCUIT | HI-201-5 SCREENED |
| U 027 | 1 | 51-80395A17 | INTEGRATED CIRCUIT | ADS36AKH SCREENED |
| U 028 | 1 | 51-80396A19 | INTEGRATED CIRCUIT | LF356N SCREENED |
| U 029 | 1 | 51-80296A17 | INTEGRATED CIRCUIT | 8704CJ SCREENED |
| U 030 | 1 | 51-80368A62 | INTEGRATED CIRCUIT | LM308AN SCREENED |
| U 031 | 1 | 51-80368A56 | INTEGRATED CIRCUIT | MC1403U SCREENED |
| U 032 | 1 | 51-80368A42 | INTEGRATED CIRCUIT | MC14070BCP SCREENE |
| U 033 | 1 | 51-80368A41 | INTEGRATED CIRCUIT | MC14069BCP SCREENE |
| U 034 | 1 | 51-80396A19 | INTEGRATED CIRCUIT | LF356N SCREENED |
| U 035 | 1 | 51-80396A20 | INTEGRATED CIRCUIT | MC6840P SCREENED |
| U 036 | 1 | 51-80346A55 | INTEGRATED CIRCUIT | SN74LS10N SCREENED |

Figure 13-3. Processor I/O A7 (RTC-4025A) Parts Location Diagram (Sheet 2 of 2)

# SECTION 14
# IEEE INTERFACE MODULE (A8)

**14-1. General.** Remote control of the system is possible using a IEEE-488 bus and the IEEE Interface Module. The Interface Module provides the interface for the 488 bus and provides for processor control of most of the functions normally controlled from the front panel. A block diagram of the IEEE Interface Module is shown in figure 14-1 with its schematic shown in figure 14-2. See section 21 for information on the use of the IEEE Bus for system control.

**14-2. IEEE Bus Interface.** Bus buffering and interface protocol as defined by the IEEE-488 specification is provided for by the IEEE Bus Interface circuit. The system processor accesses the interface directly through its address, data, and control buses for reading from or writing to the IEEE bus.

**14-3. RF Level Control.** The RF Level Control circuitry selects between the 5 VDC + AM MOD or the AM MOD + DC REF (I) input for remote or local control respectively. For remote control the 5 VDC + AM MOD input is electronically attenuated to provide the requested RF output level. For local control the attenuator is programmed for unity gain so that the AM MOD + DC REF (I) signal from the front panel RF level potentiometer controls the RF output level.

14-4. For the IEEE control option, a electronically programmable RF step attenuator is installed in the system. Control of the attenuator is then from the processor through the Address Decode and Control Latch circuitry on the Interface Module.

**14-5. Modulation Control.** Each of the three modulation sources are individually controllable by the IEEE Bus Interface module. For remote control the respective modulation input (INT MOD (I), EXT MOD (I), and 1 kHz SINE) is switched to a programmable attenuator. The system processor selects the level of attenuation necessary to provide the requested level of modulation. For local control the attenuators are programmed for unity gain and the respective modulation signal from the front panel level control (INT MOD RTN (I), EXT MOD RTN (I), and 1 kHz SINE RTN (I)) is selected to the attenuator to provide modulation level control.

**14-6. Address Decode and Control Latches.** The system processor has direct control over the programmable attenuators on the module with the Address Decode and Control Latch circuitry. Control data on the data bus (D0-D7) is latched at the Control Latch indicated by the address bus (A0-A15).

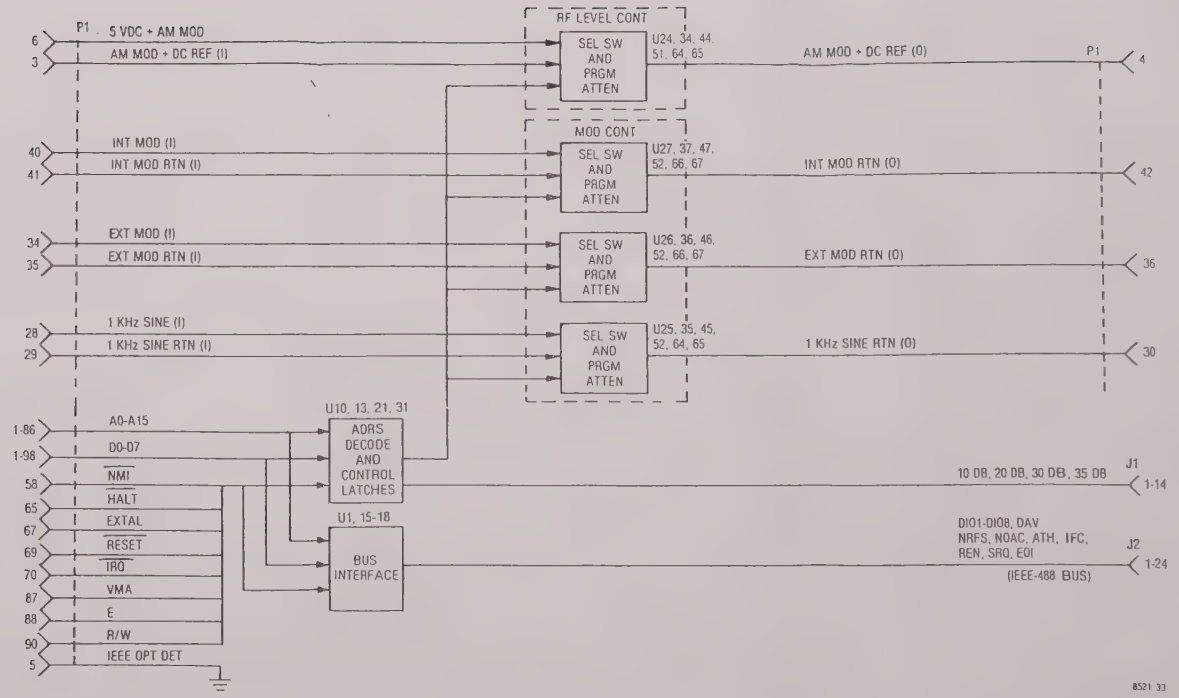



Figure 14-1. IEEE Interface Module A8 Block Diagram

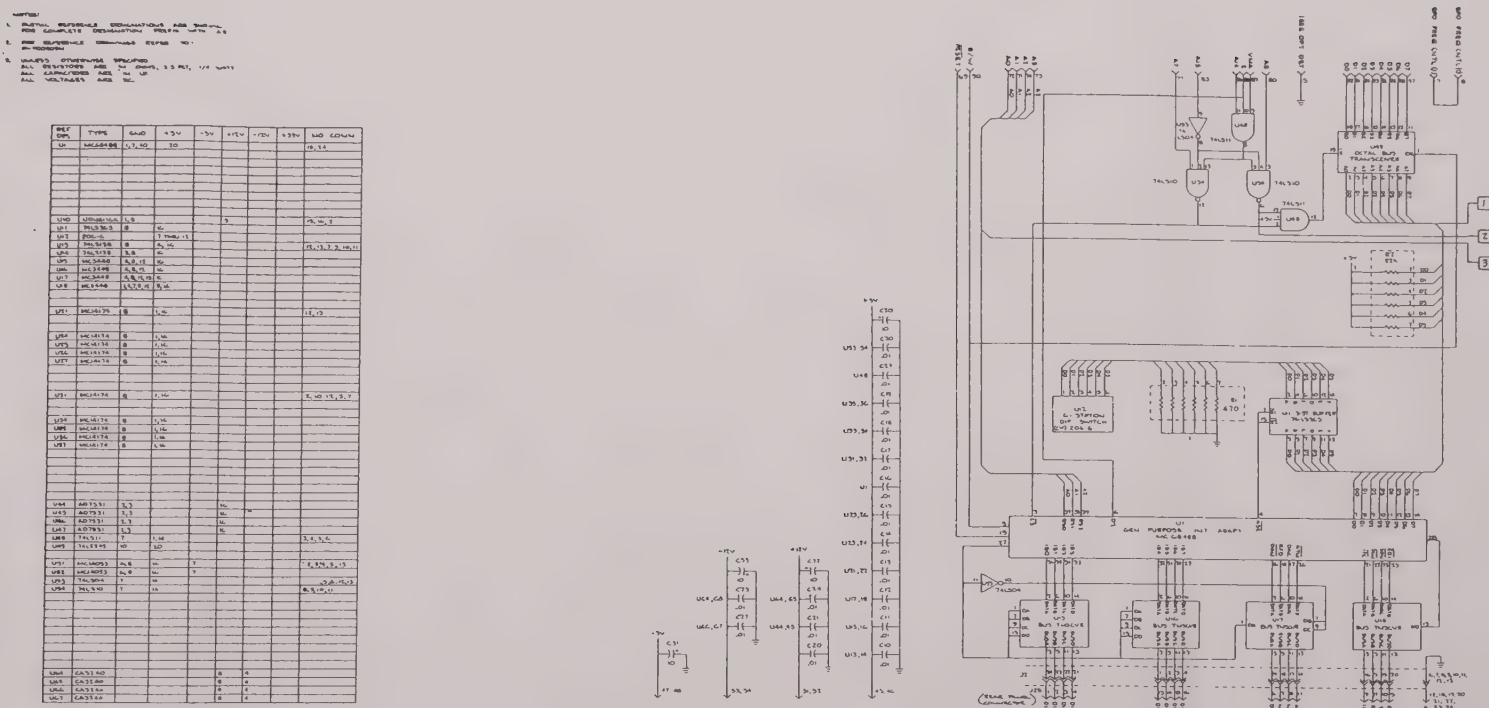


Figure 14-2. IEEE Interface Module A8
Schematic Diagram (Sheet 1 of 2)

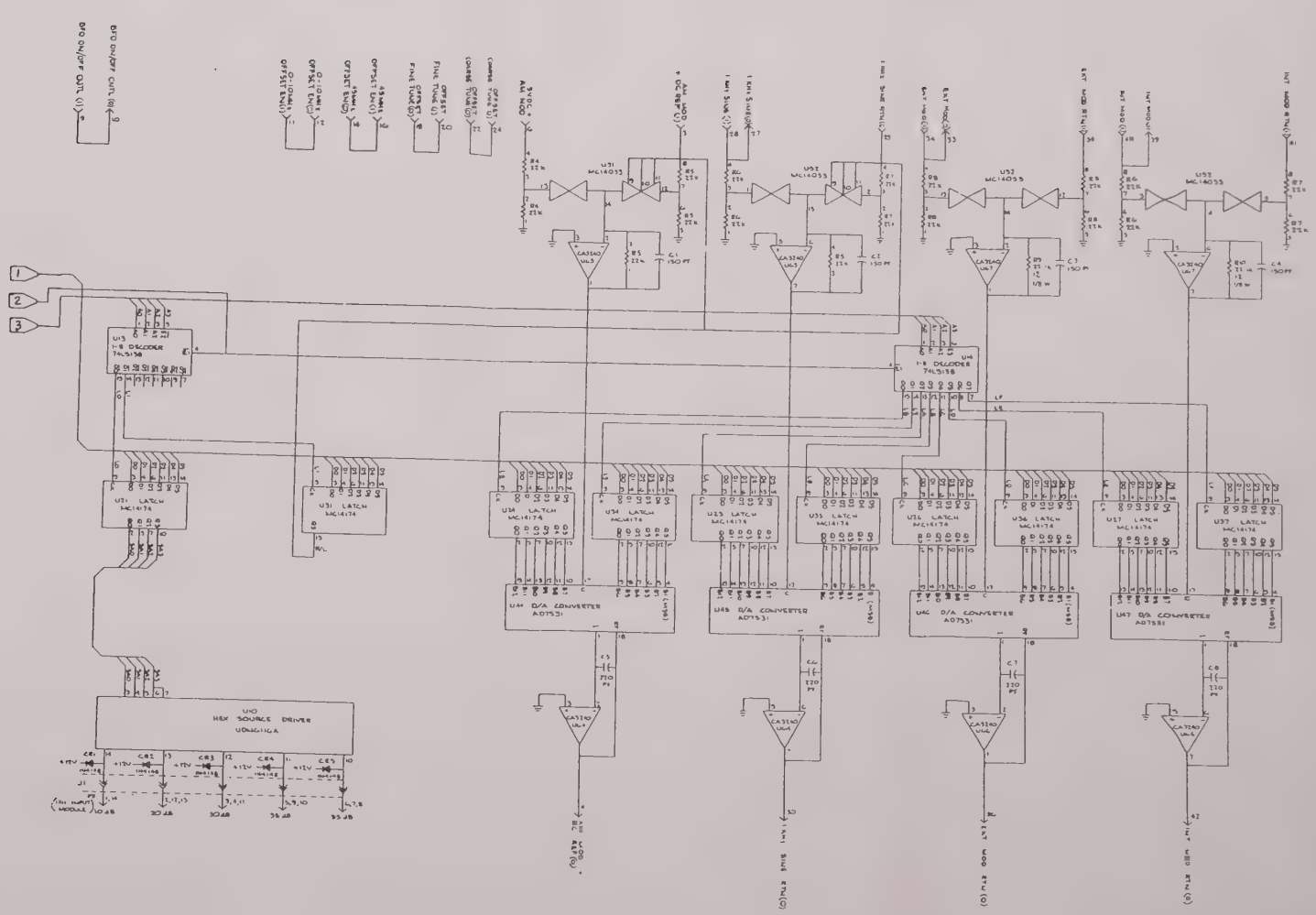


Figure 14-2. IEEE Interface Module A8
Schematic Digram (Sheet 2 of 2)

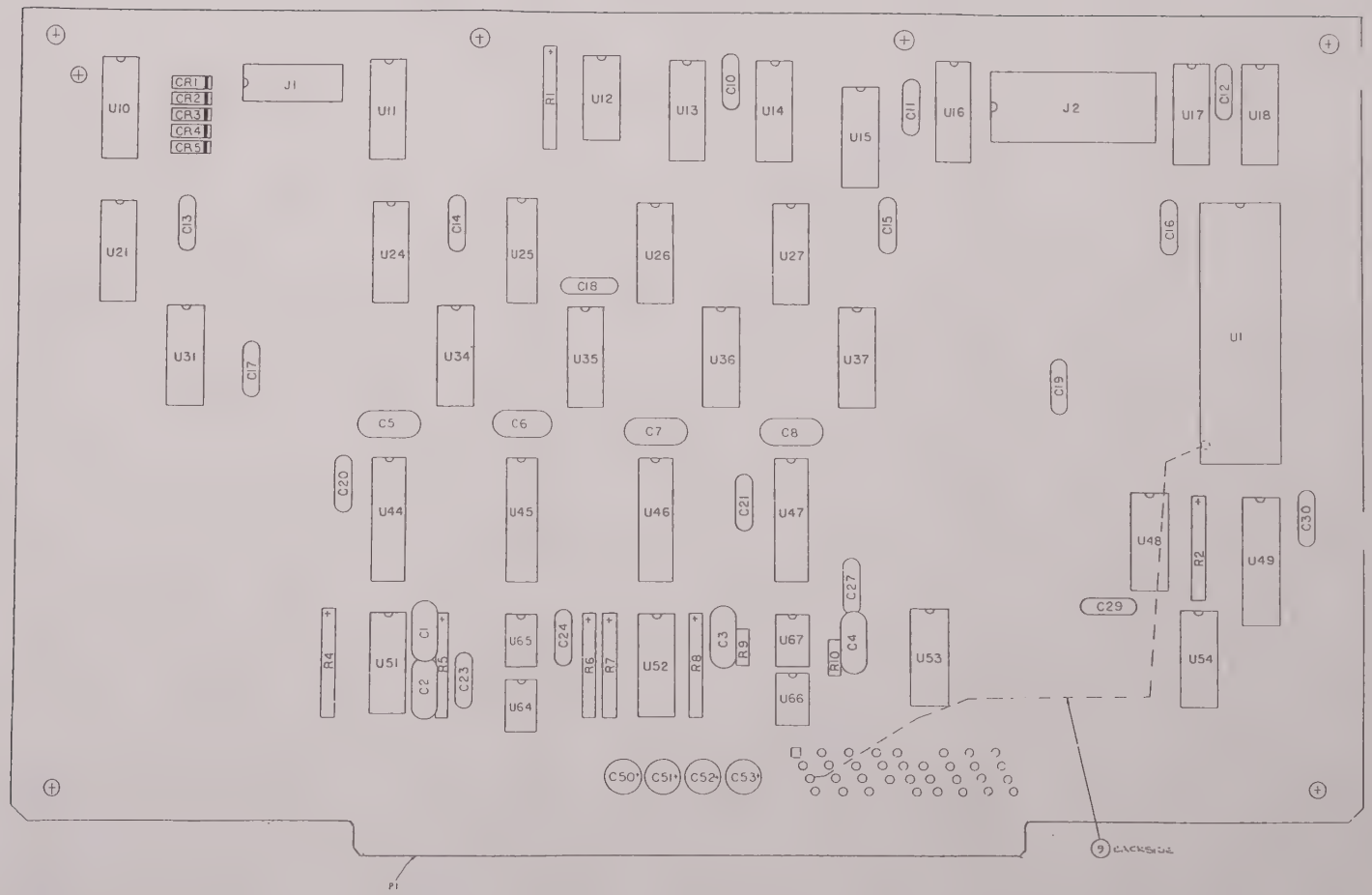



Figure 14-3. IEEE Interface Module A8 (RTC-4013B) Parts Location Diagram (Sheet 1 of 2)

| Find No. | Qty. Req. | Part No. | Nomenclature | Part Value |
|---|---|---|---|---|
| | | RTC-4013B | IEEE INTERFACE | |
| 001 | 1 | 84-P00204N001 | PWB,IEEE INTERFACE | |
| 002 | AR | SN63WRMAP3 | SOLDER | |
| 003 | AR | 11-14167A01 | INK | BLACK |
| 004 | 1 | 07-80335A63 | BRACKET,PWB MTG | |
| 005 | 4 | MS20470AD4-5 | RIVET | 1"8X.312 |
| 006 | 2 | 5C84500B03 | EYELET | |
| 007 | 2 | 42C84284B01 | RETAINER | |
| 008 | 2 | 03-139581 | SCREW,PH | 4-40X.312 |
| 009 | AR | | WIRE | #26 |
| C 001 | 1 | 21D82187B49 | CAPACITOR | 150PF-10-500 |
| C 002 | 1 | 21D82187B49 | CAPACITOR | 150PF-10-500 |
| C 003 | 1 | 21D82187B49 | CAPACITOR | 150PF-10-500 |
| C 004 | 1 | 21D82187B49 | CAPACITOR | 150PF-10-500 |
| C 005 | 1 | 21D82187B08 | CAPACITOR | 220PF-10-500 |
| C 006 | 1 | 21D82187B08 | CAPACITOR | 220PF-10-500 |
| C 007 | 1 | 21D82187B08 | CAPACITOR | 220PF-10-500 |
| C 008 | 1 | 21D82187B08 | CAPACITOR | 220PF-10-500 |
| C 010 | 1 | 21-80396A52 | CAPACITOR | .01UF-20 + 80-200 |
| C 011 | 1 | 21-80396A52 | CAPACITOR | .01UF-20 + 80-200 |
| C 012 | 1 | 21-80396A52 | CAPACITOR | .01UF-20 + 80-200 |
| C 013 | 1 | 21 80396A52 | CAPACITOR | .01UF-20 + 80-200 |
| C 014 | 1 | 21-80396A52 | CAPACITOR | .01UF-20 + 80-200 |
| C 015 | 1 | 21-80396A52 | CAPACITOR | .01UF-20 + 80-200 |
| C 016 | 1 | 21-80396A52 | CAPACITOR | .01UF-20 + 80-200 |
| C 017 | 1 | 21-80396A52 | CAPACITOR | .01UF-20 + 80-200 |
| C 018 | 1 | 21-80396A52 | CAPACITOR | .01UF-20 + 80-200 |
| C 019 | 1 | 21-80396A52 | CAPACITOR | .01UF-20 + 80-200 |
| C 020 | 1 | 21-80396A52 | CAPACITOR | .01UF-20 + 80-200 |
| C 021 | 1 | 21-80396A52 | CAPACITOR | .01UF-20 + 80-200 |
| C 023 | 1 | 21-80396A52 | CAPACITOR | .01UF-20 + 80-200 |
| C 024 | 1 | 21-80396A52 | CAPACITOR | .01UF-20 + 80-200 |
| C 027 | 1 | 21-80396A52 | CAPACITOR | .01UF-20 + 80-200 |
| C 029 | 1 | 21-80396A52 | CAPACITOR | .01UF-20 + 80-200 |
| C 030 | 1 | 21-80396A52 | CAPACITOR | .01UF-20 + 80-200 |
| C 050 | 1 | 23-80396A40 | CAPACITOR | 10UF-25V |
| C 051 | 1 | 23-80396A40 | CAPACITOR | 10UF-25V |
| C 052 | 1 | 23-80396A40 | CAPACITOR | 10UF-25V |
| C 053 | 1 | 23-80396A40 | CAPACITOR | 10UF-25V |
| CR001 | 1 | 48-84463K02 | DIODE | |
| CR002 | 1 | 48-84463K02 | DIODE | |
| CR003 | 1 | 48-84463K02 | DIODE | |
| CR004 | 1 | 48-84463K02 | DIODE | |
| CR005 | 1 | 48-84463K02 | DIODE | |
| J 001 | 1 | 09-80313A09 | SOCKET | 14 PIN |
| J 002 | 1 | 09-80331A86 | SOCKET | 24 PIN |
| R 001 | 1 | 51-80396A22 | RESISTOR NETWORK | HEX SIP,470 OHM |
| R 002 | 1 | 51-80368A77 | RESISTOR NETWORK | HEX SIP |
| R 004 | 1 | 51-80368A78 | RESISTOR NETWORK | QUAD SIP |
| R 005 | 1 | 51-80368A78 | RESISTOR NETWORK | QUAD SIP |
| R 006 | 1 | 51-80368A78 | RESISTOR NETWORK | QUAD SIP |
| R 007 | 1 | 51-80368A78 | RESISTOR NETWORK | QUAD SIP |
| R 008 | 1 | 51-80368A78 | RESISTOR NETWORK | QUAD SIP |
| R 009 | 1 | 06-10621D25 | RESISTOR | 22.1K-1-1/8 |
| R 010 | 1 | 06-10621D25 | RESISTOR | 22.1K-1-1/8 |
| U 001 | 1 | 51-80346A52 | INTEGRATED CIRCUIT | MC68488P SCREENED |
| U 010 | 1 | 51-80346A63 | INTEGRATED CIRCUIT | |
| U 011 | 1 | 51-80345A31 | INTEGRATED CIRCUIT | SN74LS365N SCREENE |
| U 012 | 1 | 40-80369A07 | SWITCH | |
| U 013 | 1 | 51-80346A57 | INTEGRATED CIRCUIT | SN74LS138N SCREENE |
| U 014 | 1 | 51-80346A57 | INTEGRATED CIRCUIT | SN74LS138N SCREENE |
| U 015 | 1 | 51-80346A51 | INTEGRATED CIRCUIT | MC3448 SCREENED |
| U 016 | 1 | 51-80346A51 | INTEGRATED CIRCUIT | MC3448 SCREENED |
| U 017 | 1 | 51-80346A51 | INTEGRATED CIRCUIT | MC3448 SCREENED |
| U 018 | 1 | 51-80346A51 | INTEGRATED CIRCUIT | MC3448 SCREENED |
| U 021 | 1 | 51-80346A50 | INTEGRATED CIRCUIT | MC14174BCP SCREENE |
| U 024 | 1 | 51-80346A50 | INTEGRATED CIRCUIT | MC14174BCP SCREENE |
| U 025 | 1 | 51-80346A50 | INTEGRATED CIRCUIT | MC14174BCP SCREENE |
| U 026 | 1 | 51-80346A50 | INTEGRATED CIRCUIT | MC14174BCP SCREENE |
| U 027 | 1 | 51-80346A50 | INTEGRATED CIRCUIT | MC14174BCP SCREENE |
| U 031 | 1 | 51-80346A50 | INTEGRATED CIRCUIT | MC14174BCP SCREENE |
| U 034 | 1 | 51-80346A50 | INTEGRATED CIRCUIT | MC14174BCP SCREENE |
| U 035 | 1 | 51-80346A50 | INTEGRATED CIRCUIT | MC14174BCP SCREENE |
| U 036 | 1 | 51-80346A50 | INTEGRATED CIRCUIT | MC14174BCP SCREENE |
| U 037 | 1 | 51-80346A50 | INTEGRATED CIRCUIT | MC14174BCP SCREENE |
| U 044 | 1 | 51-80345A98 | INTEGRATED CIRCUIT | AD7531JPN SCREENED |
| U 045 | 1 | 51-80345A98 | INTEGRATED CIRCUIT | AD7531JPN SCREENED |
| U 046 | 1 | 51-80345A98 | INTEGRATED CIRCUIT | AD7531JPN SCREENED |
| U 047 | 1 | 51-80345A98 | INTEGRATED CIRCUIT | AD7531JPN SCREENED |
| U 048 | 1 | 51-80346A56 | INTEGRATED CIRCUIT | SN74LS11N SCREENED |
| U 049 | 1 | 51-80368A20 | INTEGRATED CIRCUIT | SN74LS245NS SCREEN |
| U 051 | 1 | 51-80368A39 | INTEGRATED CIRCUIT | MC14053BCP SCREENE |
| U 052 | 1 | 51-80368A39 | INTEGRATED CIRCUIT | MC14053BCP SCREENE |
| U 053 | 1 | 51-80368A11 | INTEGRATED CIRCUIT | SN74LS04NS SCREENE |
| U 054 | 1 | 51-80346A55 | INTEGRATED CIRCUIT | SN74LS10N SCREENED |
| U 064 | 1 | 51-80345A04 | INTEGRATED CIRCUIT | CA3240E SCREENED |
| U 065 | 1 | 51-80345A04 | INTEGRATED CIRCUIT | CA3240E SCREENED |
| U 066 | 1 | 51-80345A04 | INTEGRATED CIRCUIT | CA3240E SCREENED |
| U 067 | 1 | 51-80345A04 | INTEGRATED CIRCUIT | CA3240E SCREENED |

Figure 14-3. IEEE Interface Module A8 (RTC-4013B) Parts Location Diagram (Sheet 2 of 2)

# SECTION 15
# PROCESSOR MODULE (A9)

**15-1. GENERAL.** The processor module provides primary control and data manipulations for the system. This module contains a processor and buffer, a program memory (ROM), a nonvolatile memory (NVM), a random access memory (RAM), a peripheral interface adapter (PIA), a timing generator, and a character generator. Input and output information is via the peripheral interface adapter and the address, data, and control buses. A block diagram and a schematic diagram of the module is shown in figure 15-1 and figure 15-2, respectively.

**15.2 PROCESSOR AND BUFFER.** The processor is a Motorola microprocessor MC6802, operating at a 1 MHz clock rate. This microprocessor controls the processor module via the three signal buses. The address bus provides access to the selected device for data transfers (read/write) from the data bus. Synchronization of the data transfer and specialized processor functions are provided through the control bus.

**15-3. PROGRAM MEMORY (ROM).** The series of commands (program instructions) that direct microprocessor action are contained in the ROM (Read Only Memory). This ROM is comprised of two 8192 × 8-bit read only memories. An additional 8192 x 8-bit read only memory is provided with the IEEE option.

**15-4. NONVOLATILE MEMORY (NVM).** The nonvolatile memory provides storage for 1024 four-bit words. Data that is to be held during power off is held in the NVM, which consists of a battery backed RAM (Random Access Memory). When the power is turned on, the microprocessor reads the NVM contents to obtain its start up mode, the RF and tone memory presets, and the remainder of the preset data. If the operator changes a preset, the microprocessor changes the data in the NVM so that the new preset will be remembered.

**15-5. RANDOM ACCESS MEMORY (RAM).** The random access memory provides temporary storage for both the processor and the CRT alphanumeric display. The RAM has provision to store 1024 eight-bit words, of which 512 are used for the CRT display data. Data is written into and read out of the RAM by the microprocessor.

**15-6. PERIPHERAL INTERFACE ADAPTER (PIA).** The peripheral interface adapter provides input and output latches for external data from/to the processor module. There are nine inputs from the keyboard, four column inputs (KYBD COL 0-3), and five row inputs (KYBD ROW 0-4). A single input (IEEE OPT DET) signals the processor that the IEEE option is installed. The AF BUS EN 1 output signal synchronizes the transfer of data on the system AF control bus.

**15-7. TIMING GENERATOR.** The timing generator provides the timing signals for the character generator. All of the timing signals are synchronized to the 1 MHz master clock signal from the processor. A x2 multiplier provides a 2 MHz clock to the 8-bit shift register, which in turn provides the dot clock. Additionally, the 1 MHz is successively divided through a divide-by-four circuit then through a 12-binary counter to provide the remaining clock requirements.

**15-8. CHARACTER GENERATOR.** The character generator sequentially accesses that part of the RAM where character information is stored and causes the respective characters to be displayed on the screen. Since both the character generator and the processor share the same RAM, the two must be synchronized so they access the RAM during alternate half cycles of the master clock. The 1 MHz master clock signal, from the processor is used to synchronize the 2 MHz dot clock.

15-9. Characters are displayed on the CRT as eight-by-eight dot matrices. Thirty-two dot matrices, of which the last two are always blank, make one character line. Sixteen lines, of which the last line is always blank, complete the display area. Therefore, the total number of matrices available for character display is 30 x 15 or 450 matrices. The blank matrices and the blank line are used for horizontal and vertical retrace blanking, respectively. The display is generated by dot rows. As the CRT sweeps the first dot row of a character line, the character generator outputs a serial bit pattern of 1's and 0's that turn the crt intensity on and off. The result is a row of dots that when combined with the next seven rows form a character.

15-10. A select switch, on the data and address buses to the RAM, toggles at the master clock rate of 1 MHz. This results in the processor and the character generator having access to the RAM alternately every other 0.5 microseconds. The processor stores in the RAM an 8-bit word that represent the character to be displayed. The character generator scans the RAM in sequence with the CRT display scan. As each location in the RAM is addressed, the 8-bit word stored at that location is latched by the 8-bit latch. Seven of the bits in the latch are applied to the character ROM, the eighth bit is not used. The timing generator provides 3 bits which indicates which row of dots are being scanned. The 10 bits applied to the character ROM, define a specific dot row of a particular character. An 8-bit pattern, defining that row of the character, is parallel-loaded into the 8-bit shift register. These 8 bits are serially shifted out of the register, at a 2 MHz rate, as the CHAR GEN Z-AXIS output signal.

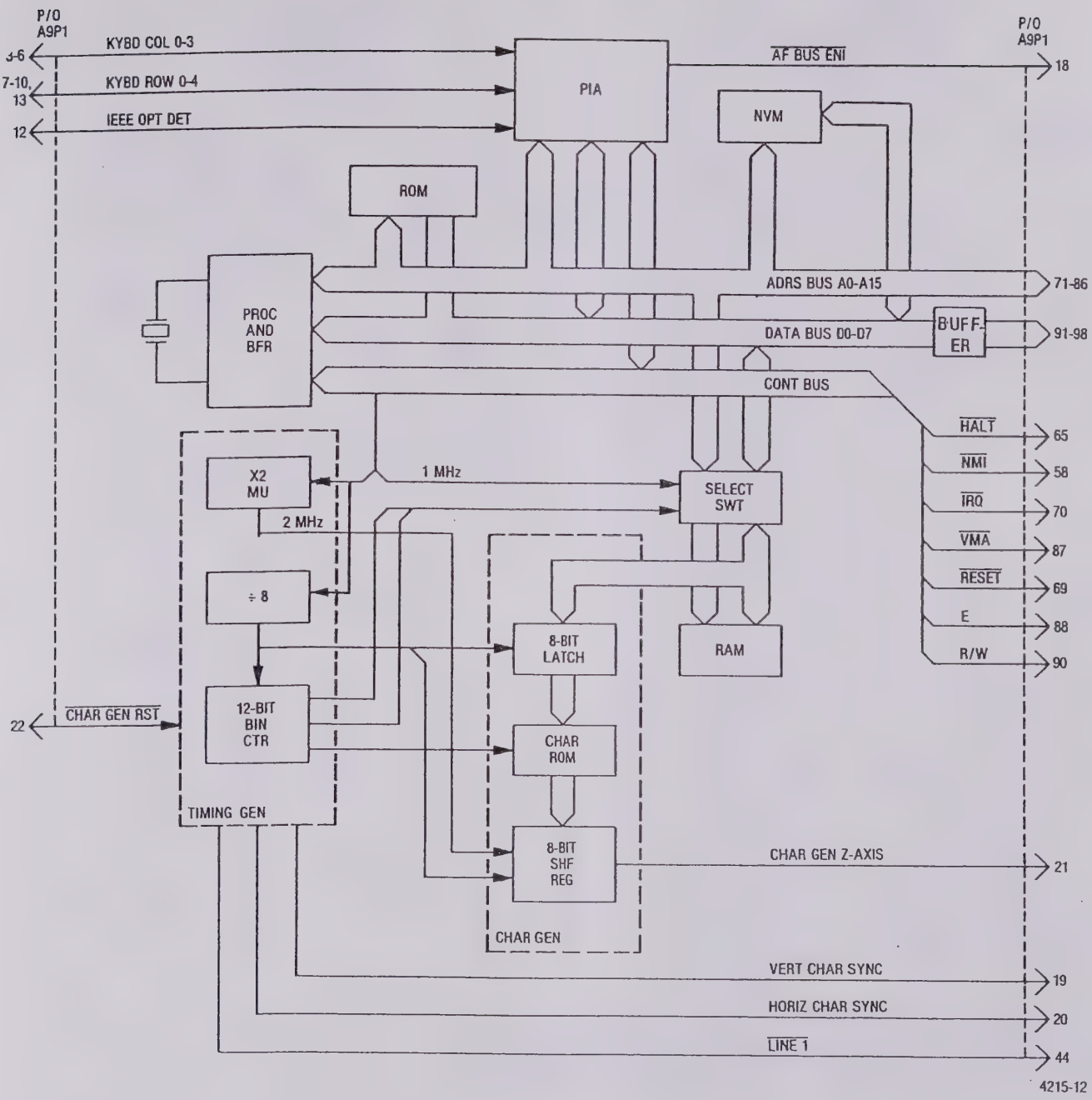



Figure 15-1. Processor Module A9 Block Diagram

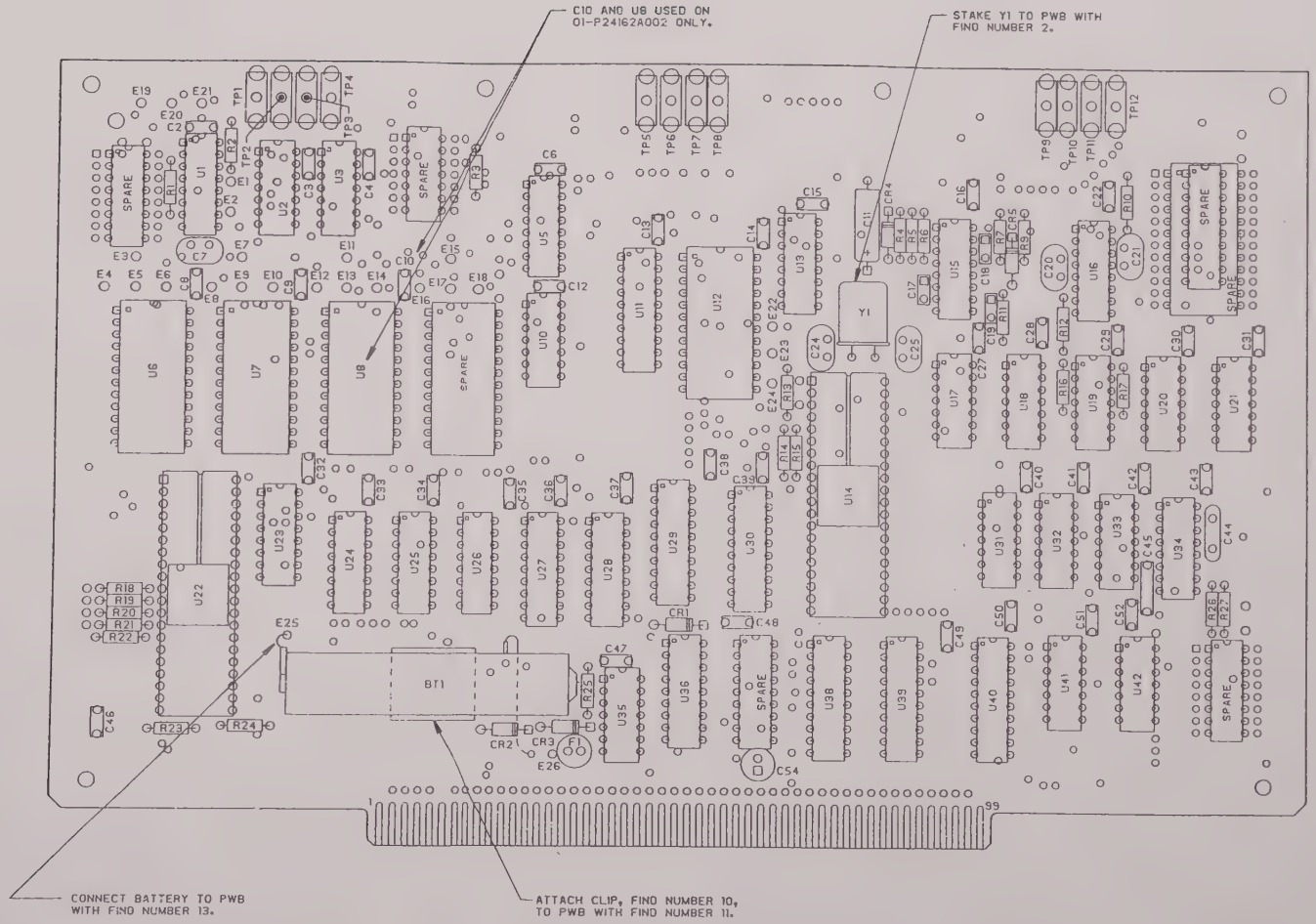

C10 AND U8 USED ON 01-P24162A002 ONLY.
STAKE Y1 TO PWB WITH FIND NUMBER 2.
CONNECT BATTERY TO PWB WITH FIND NUMBER 13.
ATTACH CLIP, FIND NUMBER 10, TO PWB WITH FIND NUMBER 11.
BT1
SPARE
1
99

Figure 15-3. Processor Module A9
Parts Location Diagram

NOTES:

1. PARTIAL REFERENCE DESIGNATION ARE SHOWN. FOR COMPLETE DESIGNATION PREFIX WITH A9.

2. FOR REFERENCE DRAWINGS REFER TO:
   ASSEMBLY 01-P24162A
   PWB 84 P24173A

3. UNLESS OTHERWISE SPECIFIED:
   ALL RESISTORS ARE IN OHMS, ±5 PCT., 1/4 WATT.
   ALL CAPACITORS ARE IN UF.
   ALL VOLTAGES ARE DC.

4. DEVICE TYPE AND CONNECTIONS NOT SHOWN ON SYMBOL ARE LISTED IN TABLE 1. UNDERLINED PORTION OF TYPE NUMBER IS USED AS A CODE TO IDENTIFY DEVICES ON DIAGRAM.

5. U8 IS USED FOR IEEE CONFIGURATION ONLY.
   EPROM MCM2532
   MUST BE PROGRAMMED WITH DATA PER IEEE PROGRAM 98-P24166A.

6. U9 IS OPTIONAL.

7. U37 IS OPTIONAL

6. C10 IS USED WITH U8 FOR ISEE CONFIGURATION ONLY

| REF DESIGNATIONS | |
|---|---|
| HIGHEST USED | NOT USED |
| BT1 | |
| C54 | C105, C23, C26, C53 |
| CR5 | |
| R27 | R8 |
| TP12 | |
| U42 * | U4 |
| Y1 | |
| F1 | |

* SEE TABLE 1

TABLE 1

| REF DES | DEVICE TYPE SEE NOTE 4 | GND | +5V | NO CONNECTION |
|---|---|---|---|---|
| U1 | 74LS221 | 8 | 16 | 3, 4, 12, 13, 14, 15 |
| U2 | 74LS10 | 7 | 14 | 12 |
| U3 | 74LS04 | 7 | 14 | 4, 6, 10 |
| U4 | NOT USED | — | — | — |
| U5 | 74LS191 | 8 | 16 | 13 |
| U6 | MCM68365P35 | 12 | 24 | |
| U7 | MCM68365P35 | 12 | 24 | |
| 5 U8 | MCM2532 | 12 | 24 | |
| 6 U9 | MCM27L16 | 12 | 24 | |
| U10 | 74LS393 | 7 | 14 | |
| U11 | 74LS374 | 10 | 20 | 19 |
| U12 | 44562 | 12 | 24 | |
| U13 | 74LS166 | 8 | 16 | |
| U14 | MC6802 | 1, 21 | 8, 35 | 7 |
| U15 | 74LS123 | 8 | 16 | 4, 5 |
| U16 | 74LS221 | 8 | 16 | 4, 12 |
| U17 | 74LS04 | 7 | 14 | 4, 10, 12 |
| U18 | 74LS260 | 7 | 14 | |
| U19 | 74LS74 | 7 | 14 | |
| U20 | 74LS74 | 7 | 14 | 6, 8, 9, 11, 12 |
| U21 | 74LS86 | 7 | 14 | 3 |
| U22 | MC6821 | 1 | 20 | |
| U23 | 74LS139 | 8 | 16 | 9, 10, 11, 12 |
| U24 | 74LS157 | 8 | 16 | |
| U25 | 74LS157 | 8 | 16 | |
| U26 | 74LS157 | 8 | 16 | 12 |
| U27 | MCM2IL14 | 9 | 18 | |
| U28 | MCM2IL14 | 9 | 18 | |
| U29 | 74LS245 | 10 | 20 | |
| U30 | 74LS245 | 10 | 20 | |
| U31 | 74LS125 | 7 | 14 | |
| U32 | 74LS20 | 7 | 14 | 3, 11 |
| U33 | 74LS00 | 7 | 14 | |
| U34 | 74LS123 | 8 | 16 | 5, 13 |
| U35 | MC14066B | 7 | | |
| U36 | 6514 | 9 | | |
| 7 U37 | 6514 | 9 | | |
| U38 | 74LS244 | 10 | 20 | |
| U39 | 74LS244 | 10 | 20 | |
| U40 | 74LS245 | 10 | 20 | |
| U41 | 74LS27 | 7 | 14 | |
| U42 | 74LS04 | 7 | 14 | |

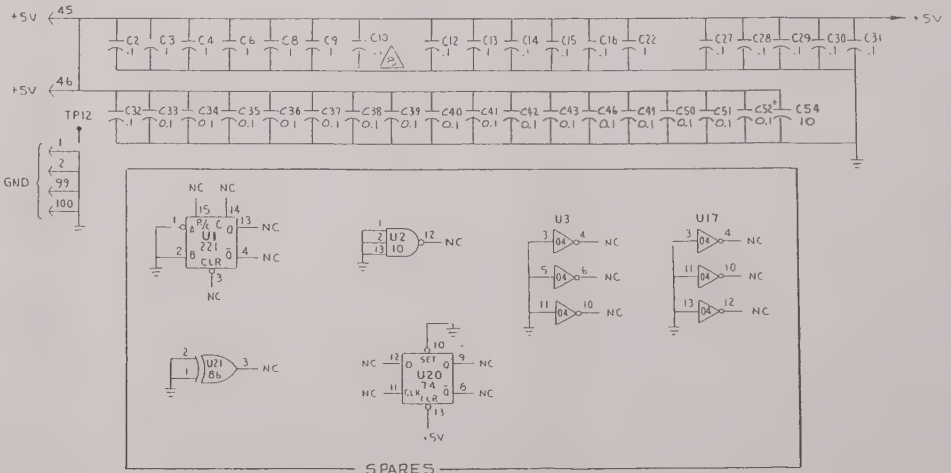



Figure 15-2. Processor Module A9 Schematic Diagram (Sheet 1 of 7)

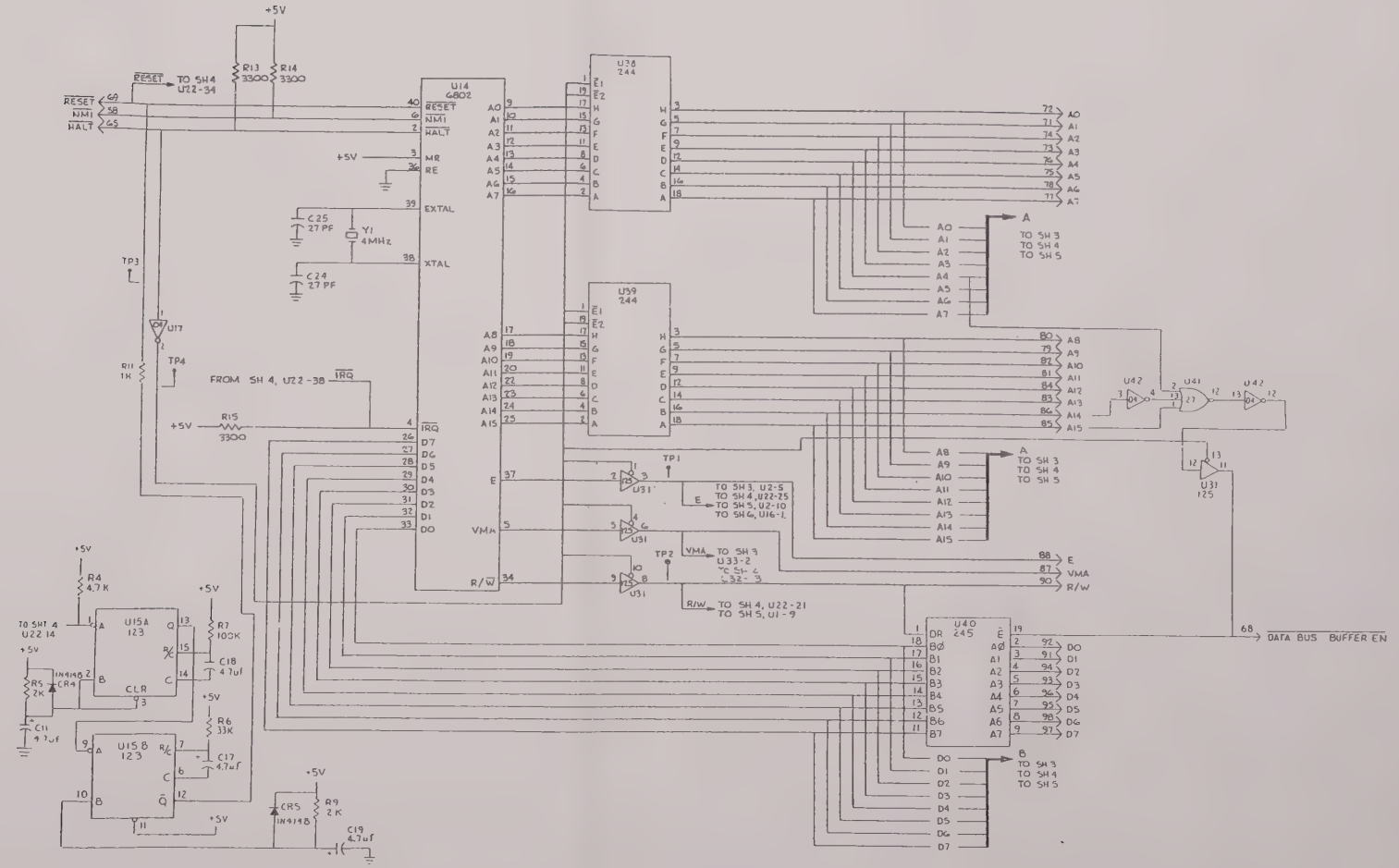



Figure 15-2. Processor Module A9 Schematic Diagram (Sheet 2 of 7)

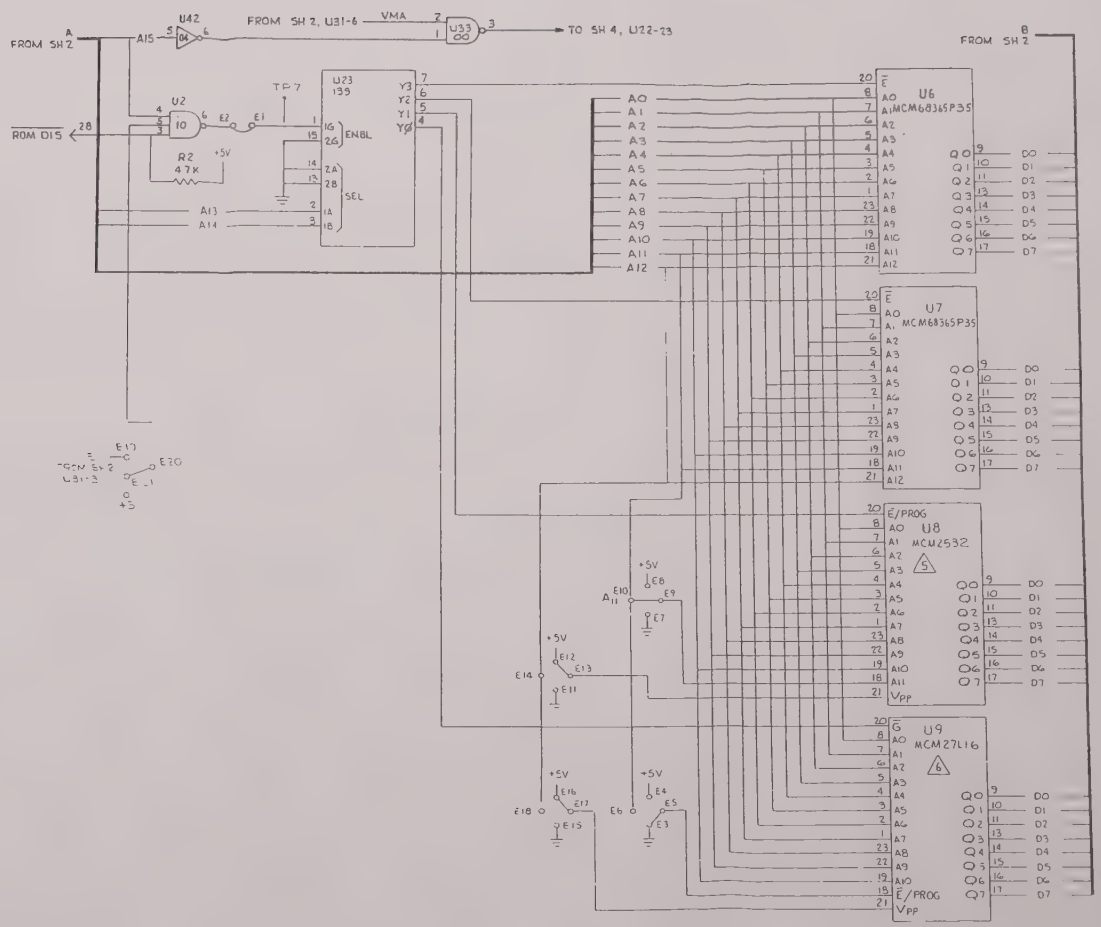



Figure 15-2. Processor Module A9 Schematic Diagram (Sheet 3 of 7)

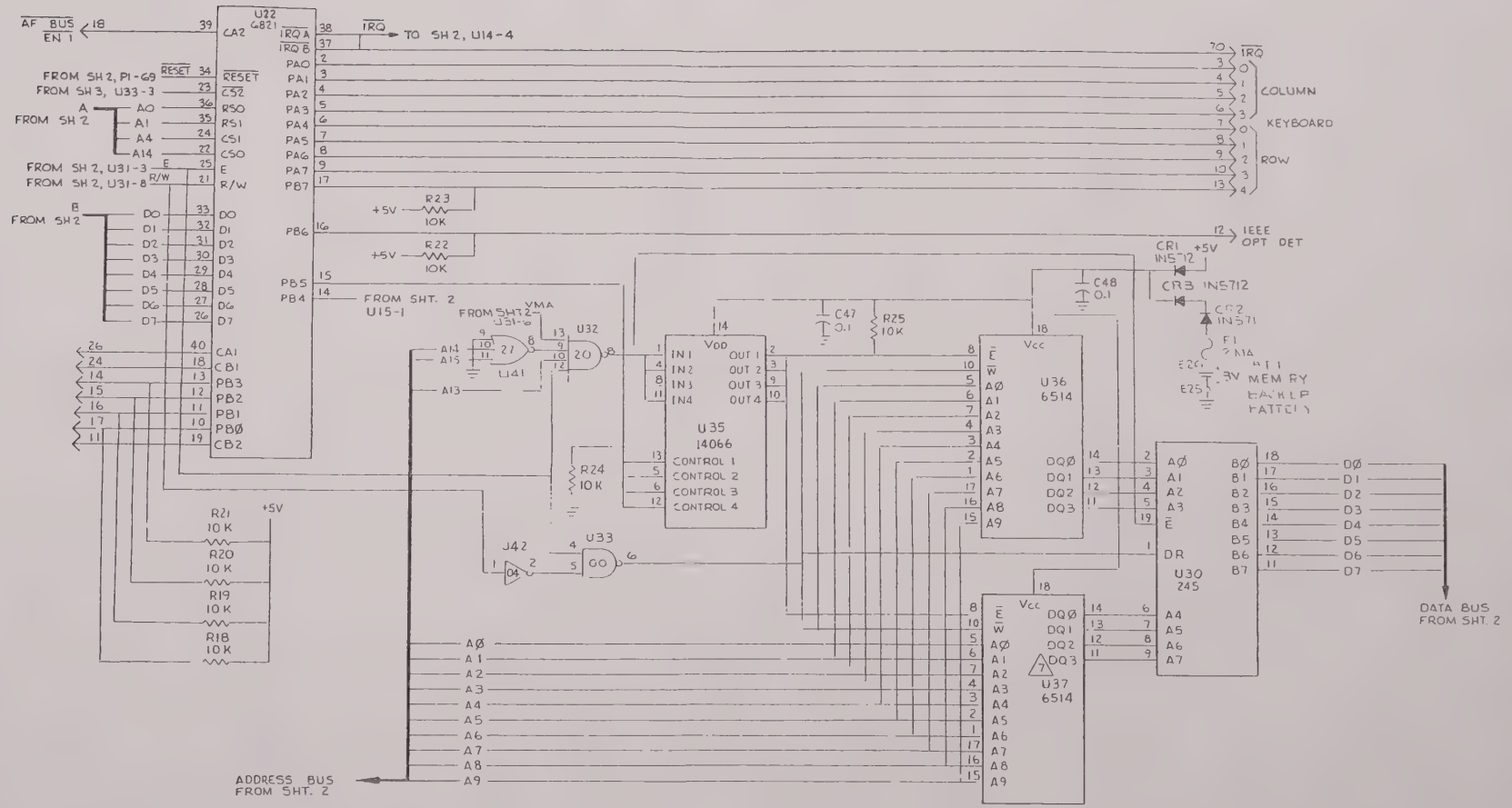



Figure 15-2. Processor Module A9
Schematic Diagram
(Sheet 4 of 7)

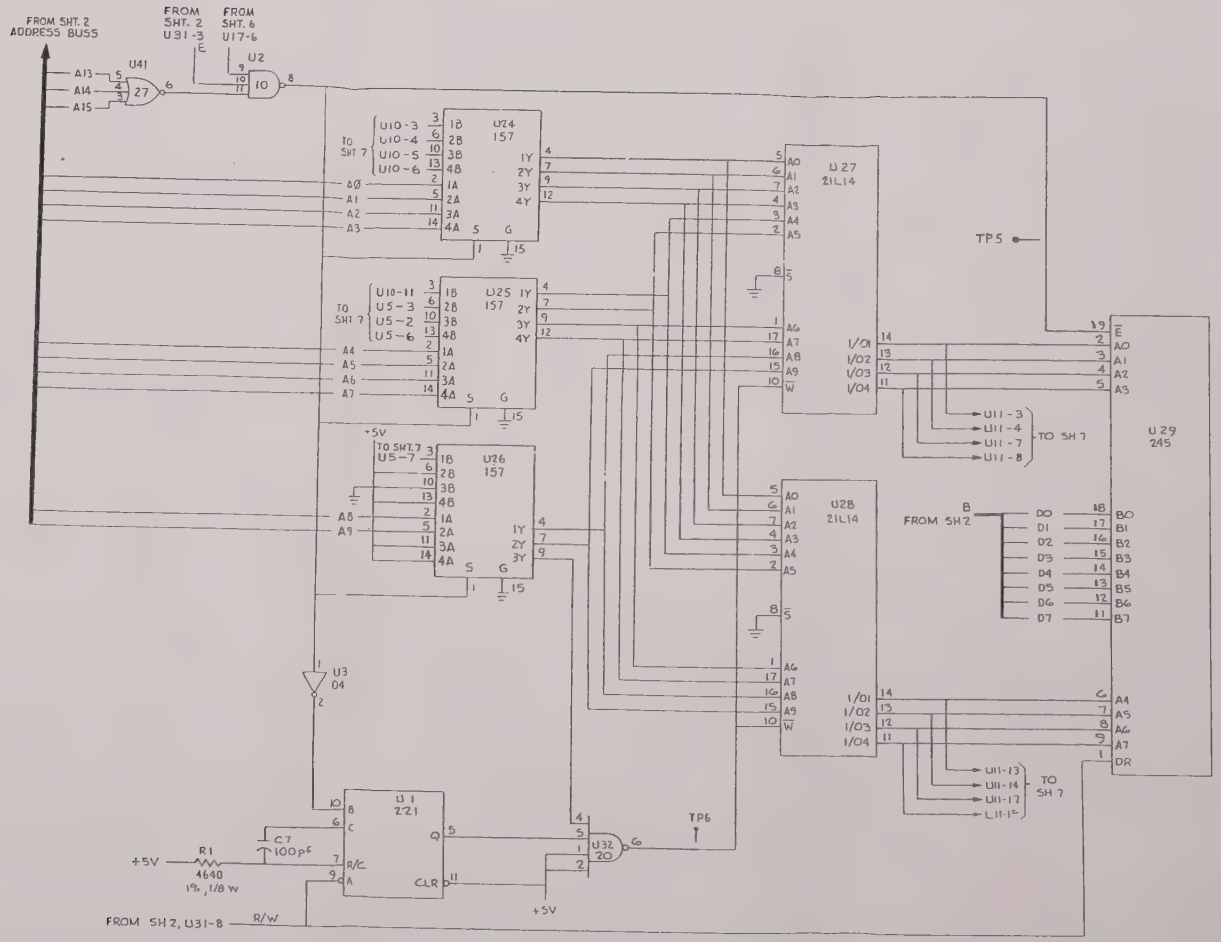



Figure 15-2. Processor Module A9 Schematic Diagram (Sheet 5 of 7)

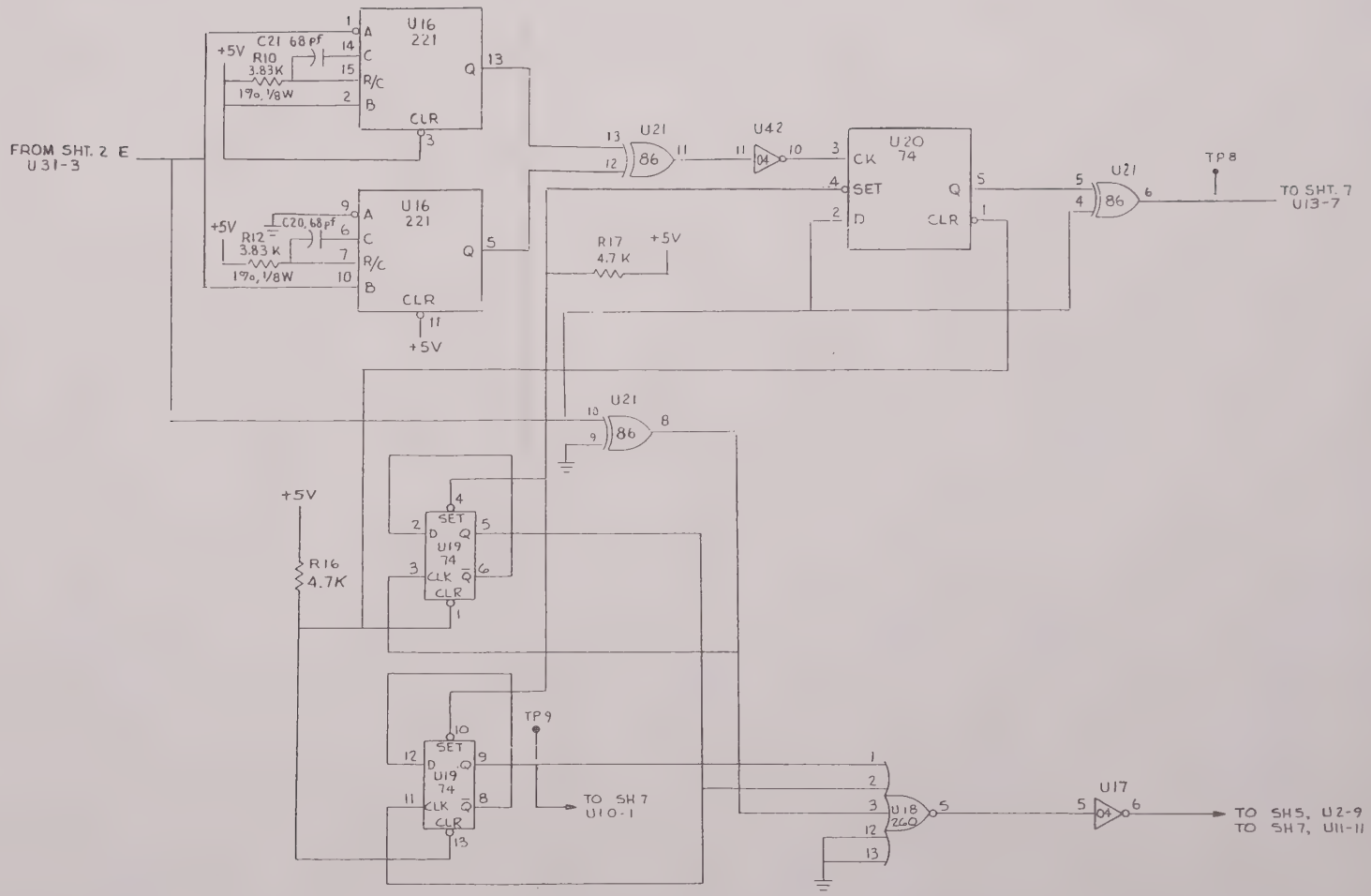



Figure 15-2. Processor Module A9
Schematic Diagram
(Sheet 6 of 7)

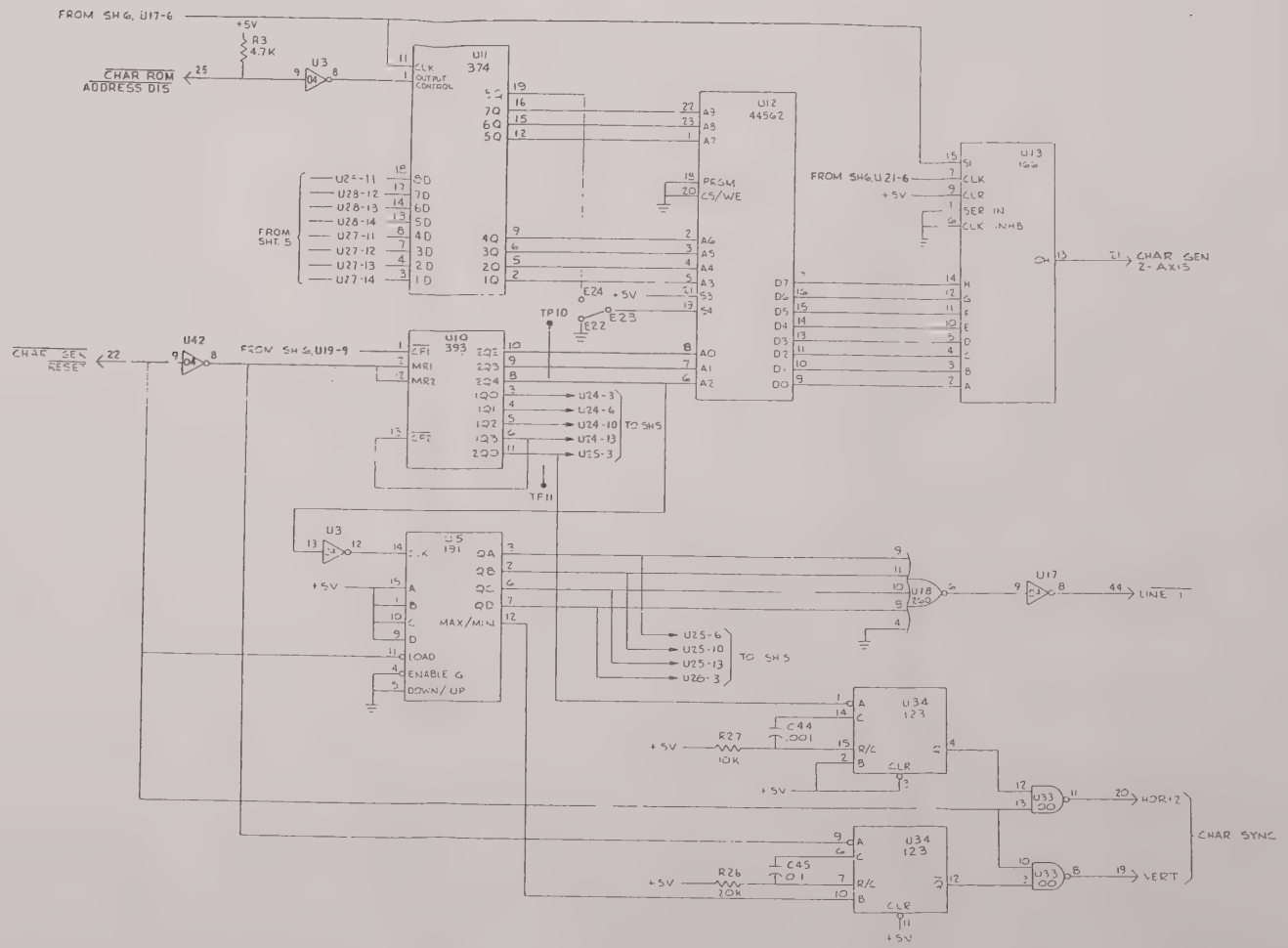



Figure 15-2. Processor Module A9 Schematic Diagram (Sheet 7 of 7).

| Find No. | Qty. Req. | Part No. | Nomenclature | Part Value |
|---|---|---|---|---|
| | | RTC-4026A | | |
| 001 | 1 | 84-P24173A001 | MICRO PROC CHAR GEN PWB,MICRO PROC CHA | |
| 002 | AR | RTV3145 | ADHESIVE,SIL RUB | |
| 003 | AR | SN63WRP3 | SOLDER | |
| 004 | AR | 11-14167A01 | INK | BLACK |
| 005 | 1 | 07-80335A63 | BRACKET,PWB MTG | |
| 006 | 4 | MS20470AD4-5 | RIVET | 1/8X.312 |
| 007 | 2 | SC84500B03 | EYELET | |
| 008 | 2 | 42C84264B01 | RETAINER | |
| 009 | 2 | 03-13958 1 | SCREW,PH | 4-40X.312 |
| 011 | 1 | 4522-44-50-1T | CLIP,COMPONENT | |
| 012 | 2 | MS20426AD3-3.5 | RIVET,UNIV HD | .093X.218 |
| 013 | AR | | WIRE,BUS | #24 WHT |
| BT001 | 1 | 60-80396A01 | BATTERY,LITHIUM-MA | 3V |
| C 002 | 1 | 21-80369A82 | CAPACITOR | .1UF-20-100 |
| C 003 | 1 | 21-80369A82 | CAPACITOR | .1UF-20-100 |
| C 004 | 1 | 21-80369A82 | CAPACITOR | .1UF-20-100 |
| C 006 | 1 | 21-80369A82 | CAPACITOR | .1UF-20-100 |
| C 007 | 1 | 21-850118 | CAPACITOR | 100PF-5-500 |
| C 008 | 1 | 21-80369A82 | CAPACITOR | .1UF-20-100 |
| C 009 | 1 | 21-80369A82 | CAPACITOR | .1UF-20-100 |
| C 011 | 1 | 23D84762H18 | CAPACITOR | 47UF-20-10 |
| C 012 | 1 | 21-80369A82 | CAPACITOR | .1UF-20-100 |
| C 013 | 1 | 21-80369A82 | CAPACITOR | .1UF-20-100 |
| C 014 | 1 | 21-80369A82 | CAPACITOR | .1UF-20-100 |
| C 015 | 1 | 21-80369A82 | CAPACITOR | .1UF-20-100 |
| C 016 | 1 | 21-80369A82 | CAPACITOR | .1UF-20-100 |
| C 017 | 1 | 23D83441B18 | CAPACITOR | 4.7UF-20-20 |
| C 018 | 1 | 23D83441B18 | CAPACITOR | 4.7UF-20-20 |
| C 019 | 1 | 23D83441B18 | CAPACITOR | 4.7UF-20-20 |
| C 020 | 1 | 21-80396A47 | CAPACITOR | 68PF-5-500 |
| C 021 | 1 | 51-80396A47 | CAPACITOR | 68PF-5-500 |
| C 022 | 1 | 21-80369A82 | CAPACITOR | .1UF-20-100 |
| C 024 | 1 | 21-80369A89 | CAPACITOR | 27PF-5-500 |
| C 025 | 1 | 21-80369A89 | CAPACITOR | 27PF-5-500 |
| C 027 | 1 | 21-80369A82 | CAPACITOR | .1UF-20-100 |
| C 028 | 1 | 21-80369A82 | CAPACITOR | .1UF-20-100 |
| C 029 | 1 | 21-80369A82 | CAPACITOR | .1UF-20-100 |
| C 030 | 1 | 21-80369A82 | CAPACITOR | .1UF-20-100 |
| C 031 | 1 | 21-80369A82 | CAPACITOR | .1UF-20-100 |
| C 032 | 1 | 21-80369A82 | CAPACITOR | .1UF-20-100 |
| C 033 | 1 | 21-80369A82 | CAPACITOR | .1UF-20-100 |
| C 034 | 1 | 21-80369A82 | CAPACITOR | .1UF-20-100 |
| C 035 | 1 | 21-80369A82 | CAPACITOR | .1UF-20-100 |
| C 036 | 1 | 21-80369A82 | CAPACITOR | .1UF-20-100 |
| C 037 | 1 | 21-80369A82 | CAPACITOR | .1UF-20-100 |
| C 038 | 1 | 21-80369A82 | CAPACITOR | .1UF-20-100 |
| C 039 | 1 | 21-80369A82 | CAPACITOR | .1UF-20-100 |
| C 040 | 1 | 21-80369A82 | CAPACITOR | .1UF-20-100 |
| C 041 | 1 | 21-80369A82 | CAPACITOR | .1UF-20-100 |
| C 042 | 1 | 21-80369A82 | CAPACITOR | .1UF-20-100 |
| C 043 | 1 | 21-80369A82 | CAPACITOR | .1UF-20-100 |
| C 044 | 1 | 21-80396A51 | CAPACITOR | 1000PF-10-100 |
| C 045 | 1 | 21-80348A89 | CAPACITOR | .1UF-20-16 |

| Find No. | Qty. Req. | Part No. | Nomenclature | Part Value |
|---|---|---|---|---|
| C 046 | 1 | 21-80369A82 | CAPACITOR | .1UF-20-100 |
| C 047 | 1 | 21-80369A82 | CAPACITOR | .1UF-20-100 |
| C 048 | 1 | 21-80369A82 | CAPACITOR | .1UF-20-100 |
| C 049 | 1 | 21-80369A82 | CAPACITOR | .1UF-20-100 |
| C 050 | 1 | 21-80369A82 | CAPACITOR | .1UF-20-100 |
| C 051 | 1 | 21-80369A82 | CAPACITOR | .1UF-20-100 |
| C 052 | 1 | 21-80369A82 | CAPACITOR | .1UF-20-100 |
| C 054 | 1 | 23-89396A40 | CAPACITOR | 10UF-25V |
| CR001 | 1 | 48-80396A27 | DIODE | |
| CR002 | 1 | 48-80396A27 | DIODE | |
| CR003 | 1 | 48-80396A27 | DIODE | |
| CR004 | 1 | 48-84463K02 | DIODE | |
| CR005 | 1 | 48-84463K02 | DIODE | |
| F 001 | 1 | 65-80396A55 | FUSE | 2MA |
| R 001 | 1 | 06-10621C39 | RESISTOR | 4640-1-1/8 |
| R 002 | 1 | 6S124A65 | RESISTOR | 4.7K-5-1/4 |
| R 003 | 1 | 6S124A65 | RESISTOR | 4.7K-5-1/4 |
| R 004 | 1 | 6S124A65 | RESISTOR | 4.7K-5-1/4 |
| R 005 | 1 | 6S124A56 | RESISTOR | 2K-5-1/4 |
| R 006 | 1 | 6S124A85 | RESISTOR | 33K-5-1/4 |
| R 007 | 1 | 6S124A97 | RESISTOR | 100K-5-1/4 |
| R 009 | 1 | 6S124A56 | RESISTOR | 2K-5-1/4 |
| R 010 | 1 | 06-10621C51 | RESISTOR | 3830-1-1/8 |
| R 011 | 1 | 6S124A49 | RESISTOR | 1K-5-1/4 |
| R 012 | 1 | 06-10621C51 | RESISTOR | 3830-T-1/8 |
| R 013 | 1 | 6S124A61 | RESISTOR | 3.3K-5-1/4 |
| R 014 | 1 | 6S124A61 | RESISTOR | 3.3K-5-1/4 |
| R 015 | 1 | 6S124A61 | RESISTOR | 3.3K-5-1/4 |
| R 016 | 1 | 6S124A65 | RESISTOR | 4.7K-5-1/4 |
| R 017 | 1 | 6S124A65 | RESISTOR | 4.7K-5-1/4 |
| R 018 | 1 | 6S124A73 | RESISTOR | 10K-5-1/4 |
| R 019 | 1 | 6S124A73 | RESISTOR | 10K-5-1/4 |
| R 020 | 1 | 6S124A73 | RESISTOR | 10K-5-1/4 |
| R 021 | 1 | 6S124A73 | RESISTOR | 10K-5-1/4 |
| R 022 | 1 | 6S124A73 | RESISTOR | 10K-5-1/4 |
| R 023 | 1 | 6S124A73 | RESISTOR | 10K-5-1/4 |
| R 024 | 1 | 6S124A73 | RESISTOR | 10K-5-1/4 |
| R 025 | 1 | 6S124A73 | RESISTOR | 10K-5-1/4 |
| R 026 | 1 | 6S124A80 | RESISTOR | 20K-5-1/4 |
| R 027 | 1 | 6S124A73 | RESISTOR | 10K-5-1/4 |
| TP001 | 1 | 09-80331A88 | JACK,TIP | WHT |
| TP002 | 1 | 09-80331A88 | JACK,TIP | WHT |
| TP003 | 1 | 09-80331A88 | JACK,TIP | WHT |
| TP004 | 1 | 09-80331A88 | JACK,TIP | WHT |
| TP005 | 1 | 09-80331A88 | JACK,TIP | WHT |
| TP006 | 1 | 09-80331A88 | JACK,TIP | WHT |
| TP007 | 1 | 09-80331A88 | JACK,TIP | WHT |
| TP008 | 1 | 09-80331A88 | JACK,TIP | WHT |
| TP009 | 1 | 09-80331A88 | JACK,TIP | WHT |
| TP010 | 1 | 09-80331A88 | JACK,TIP | WHT |
| TP011 | 1 | 09-80331A88 | JACK,TIP | WHT |
| TP012 | 1 | 09-80331A88 | JACK,TIP | WHT |
| U 001 | 1 | 51-80368A28 | INTEGRATED CIRCUIT | SN74LS221N SCREENE |

| Find No. | Qty. Req. | Part No. | Nomenclature | Part Value |
|---|---|---|---|---|
| U 002 | 1 | 51-80348A55 | INTEGRATED CIRCUIT | SN74LS10N SCREENE |
| U 003 | 1 | 51-80368A11 | INTEGRATED CIRCUIT | SN74LS04NS SCREEN |
| U 005 | 1 | 51-80396A08 | INTEGRATED CIRCUIT | |
| U 006 | 1 | SCM92113P | INTEGRATED CIRCUIT | NMOS ROM |
| U 007 | 1 | SCM92093P | INTEGRATED CIRCUIT | NMOS ROM |
| U 010 | 1 | 51-80368A22 | INTEGRATED CIRCUIT | SN74LS393NS SCREE |
| U 011 | 1 | 51-80396A12 | INTEGRATED CIRCUIT | SN74LS374NS SCREE |
| U 012 | 1 | 51-80345A12 | INTEGRATED CIRCUIT | |
| U 013 | 1 | 51-80396A15 | INTEGRATED CIRCUIT | SN74LS168 SCREENE |
| U 014 | 1 | 51-80368A71 | INTEGRATED CIRCUIT | MC6802P SCREENED |
| U 015 | 1 | 51-80368A12 | INTEGRATED CIRCUIT | SN74LS123 SCREENE |
| U 016 | 1 | 51-80368A28 | INTEGRATED CIRCUIT | SN74LS221N SCREEN |
| U 017 | 1 | 51-80368A11 | INTEGRATED CIRCUIT | SN74LS04NS SCREEN |
| U 018 | 1 | 51-80368A29 | INTEGRATED CIRCUIT | SN74LS260N SCREEN |
| U 019 | 1 | 51-80368A24 | INTEGRATED CIRCUIT | SN74LS74NS SCREEN |
| U 020 | 1 | 51-80368A24 | INTEGRATED CIRCUIT | SN74LS74NS SCREEN |
| U 021 | 1 | 51-80368A25 | INTEGRATED CIRCUIT | SN74LS86NS SCREEN |
| U 022 | 1 | 51-80368A72 | INTEGRATED CIRCUIT | MC6821P SCREENED |
| U 023 | 1 | 51-80368A14 | INTEGRATED CIRCUIT | SN74LS139NS SCREE |
| U 024 | 1 | 51-80396A11 | INTEGRATED CIRCUIT | SN74LS157NS SCREE |
| U 025 | 1 | 51-80396A11 | INTEGRATED CIRCUIT | SN74LS157NS SCREE |
| U 026 | 1 | 51-80396A11 | INTEGRATED CIRCUIT | SN74LS157NS SCREE |
| U 027 | 1 | 51-80345A11 | INTEGRATED CIRCUIT | |
| U 028 | 1 | 51-80345A11 | INTEGRATED CIRCUIT | |
| U 029 | 1 | 51-80368A20 | INTEGRATED CIRCUIT | SN74LS245NS SCREE |
| U 030 | 1 | 51-80368A20 | INTEGRATED CIRCUIT | SN74LS245NS SCREE |
| U 031 | 1 | 51-80368A13 | INTEGRATED CIRCUIT | SN74LS125ANS SCRI |
| U 032 | 1 | 51-80368A17 | INTEGRATED CIRCUIT | SN74LS20NS S |
| U 033 | 1 | 51-80368A09 | INTEGRATED CIRCUIT | SN74LS00NS S |
| U 034 | 1 | 51-80368A12 | INTEGRATED CIRCUIT | SN74LS123 SCREENEC |
| U 035 | 1 | 51-82884L48 | INTEGRATED CIRCUIT | MC14066BCP SCREEN |
| U 036 | 1 | 51-80396A21 | INTEGRATED CIRCUIT | CMOS RAM |
| U 038 | 1 | 51-80368A19 | INTEGRATED CIRCUIT | SN74LS244NS SCREEN |
| U 039 | 1 | 51-80368A19 | INTEGRATED CIRCUIT | SN74LS244NS SCREEN |
| U 040 | 1 | 51-80368A20 | INTEGRATED CIRCUIT | SN74LS245NS SCREEN |
| U 041 | 1 | 51-80396A10 | INTEGRATED CIRCUIT | SN74LS27NS SCREENE |
| U 042 | 1 | 51-80368A11 | INTEGRATED CIRCUIT | SN74LS04NS SCREENE |
| Y 001 | 1 | 48-80348A06 | CRYSTAL | 4.0MHZ |

Figure 15-3. Processor Module A9 (RTC-4026A) Parts Location Diagram (Sheet 2 of 2)

# SECTION 16
# HIGH VOLTAGE POWER SUPPLY (A10)

**16-1. GENERAL.** CRT bias and drive voltages are provided by the high voltage power supply. The power supply converts a nominal 15 VDC input to output voltages of +4kV and a −2kV. In addition, control circuits for the CRT focus and intensity grids are contained in this power supply. The high voltage power supply block and schematic diagrams are shown in figures 16-1 and 16-2, respectively.

**16-2. HIGH VOLTAGE SUPPLY.** An 8 VDC at the center tap of the high voltage transformer is switched, through the transformer primary winding by the chopper, at a 20 kHz rate. The chopper drive signals originate in the low voltage power supply. One transformer secondary winding provides a 6.3 VAC CRT heater voltage. The other transformer secondary winding provides a 1 kV to a X4 multiplier and a X2 multiplier. The output of the X4 multiplier, a nominal +4 kV is the CRT anode voltage. A nominal −2 kV output of the X2 multiplier is applied to the intensity and focus modulators. The −2 kV is regulated by comparing a sample of the −2 kV to a 6.3V reference signal. The resultant signal controls the level of the DC input at the center tap of the high voltage transformer. A bias divider, on the transformer center tap, provides the HV CHOPPER BIAS signal to the low voltage power supply.

**16-3.** INTENSITY AND FOCUS CONTROL. An 87V zener diode and a resistive divider circuit provide the intensity and focus voltages. Each modulator provides variable output voltages, within their bias range, under the control of the low voltage INTENSITY TV and FOCUS TV input signals. The grid and focus voltages are stabilized by using DC control loops. The INTENSITY SAMPLE signal and the HV REF signal are compared, on the scope amplifier module, to an input control signal. The result of this comparison is the INTENSITY TV signal. In a similar manner, the FOCUS SAMPLE signal is compared, on the scope amplifier module, to the input control signal. This results in the FOCUS TV signal.

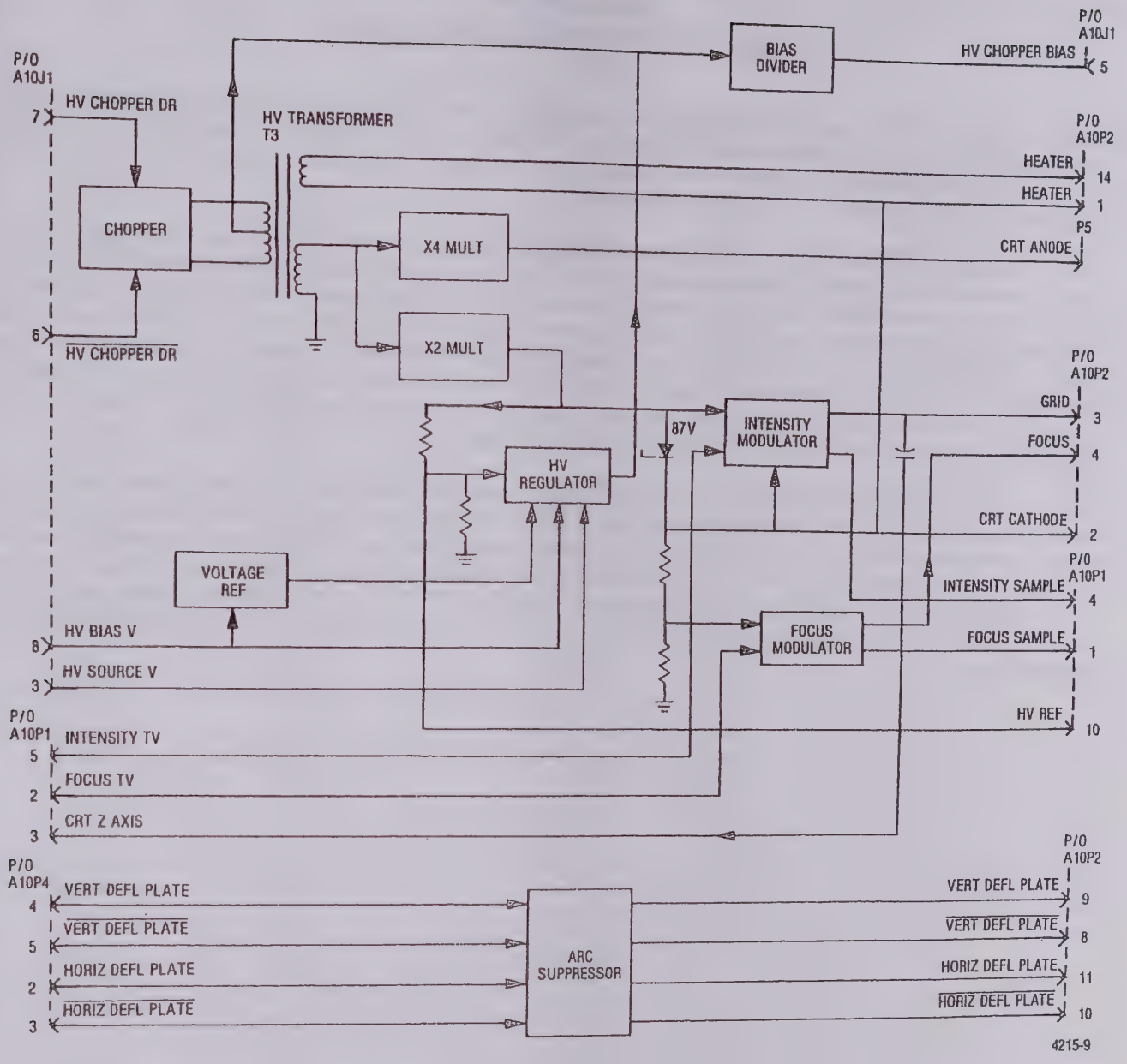



Figure 16-1. High Voltage Power Supply A10 Block Diagram

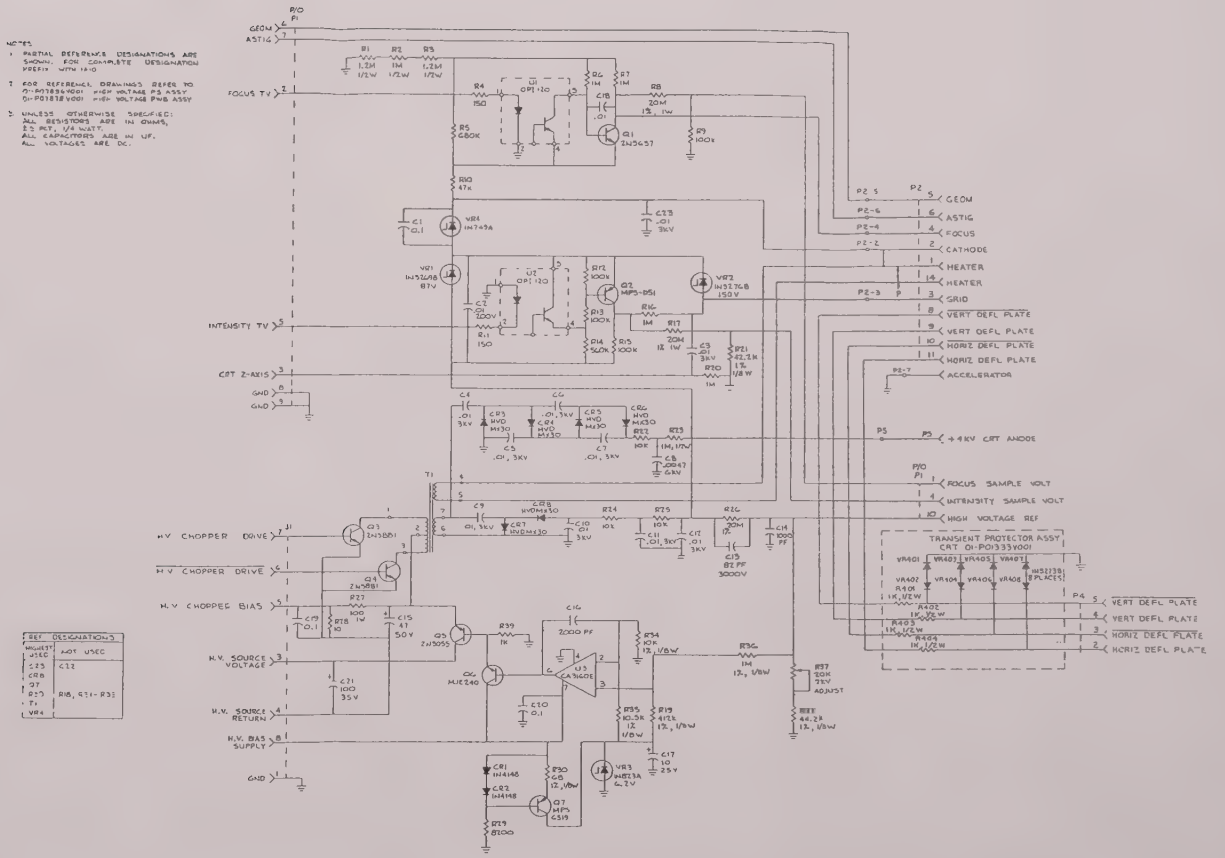



Figure 16-2. High Voltage Power Supply A10 Schematic Diagram

| Find No. | Qty. Req. | Part No. | Nomenclature | Part Value |
|---|---|---|---|---|
| A10 | | RTP-1006A | HIGH VOLT PWR SUPPLY | |
| 001 | 1 | RTP-4015A | HIGH VOLTAGE PWB A | |
| 002 | 1 | 15-P07859V001 | HOUSING,H V PWR SU | |
| 003 | 2 | 821-S-2 | SCREW,CAPTIVE | 4-40 |
| 004 | 10 | MS35206-215 | SCREW,PH | .1120-40X.375 |
| 005 | 10 | 04-7607 | WASHER,FLAT | .125 |
| 006 | 10 | 04-114583 | WASHER,LOCK | .112 |
| 007 | 6 | 2634-18031-N140 | WASHER,SHOULDER | |
| 008 | 3 | M38527/8-03P | INSULATOR,PLATE,FI | TO3 |
| 010 | AR | F01A070 | WIRE,HIGH VOLTAGE | |
| 011 | AR | | WIRE | #24 WHT |
| 012 | AR | SN63WRMAP3 | SOLDER | |
| 013 | AR | 11-14167A01 | INK | BLACK |
| 014 | 1 | 01-80304A60 | TRANSIENT PROTECTO | |
| 015 | 1 | MS35489-6 | GROMMET | |
| 016 | 1 | 14-80370A47 | INSULATOR | |
| 017 | 1 | 3016-A-2-A-9 | SPACER | |
| 018 | AR | MS3367-4-9 | STRAP,TIEDOWN | |
| 019 | AR | M23053/5-103-C | INSULATION SLEEVIN | .093 CLR |
| 020 | 1 | 33-14232A09 | PLATE,IDENT HI-V | |
| 021 | AR | 495-04 | ADHESIVE,FAST CURE | |
| 022 | AR | | TAPE,THERMOSET | 2.5 X 1W #56 |
| P 002 | 1 | 09-80331A82 | CONNECTOR,CRT | |
| Q 003 | 1 | 48-80396A25 | TRANSISTOR | |
| Q 004 | 1 | 48-80396A25 | TRANSISTOR | |
| Q 005 | 1 | 48-869302 | TRANSISTOR | |

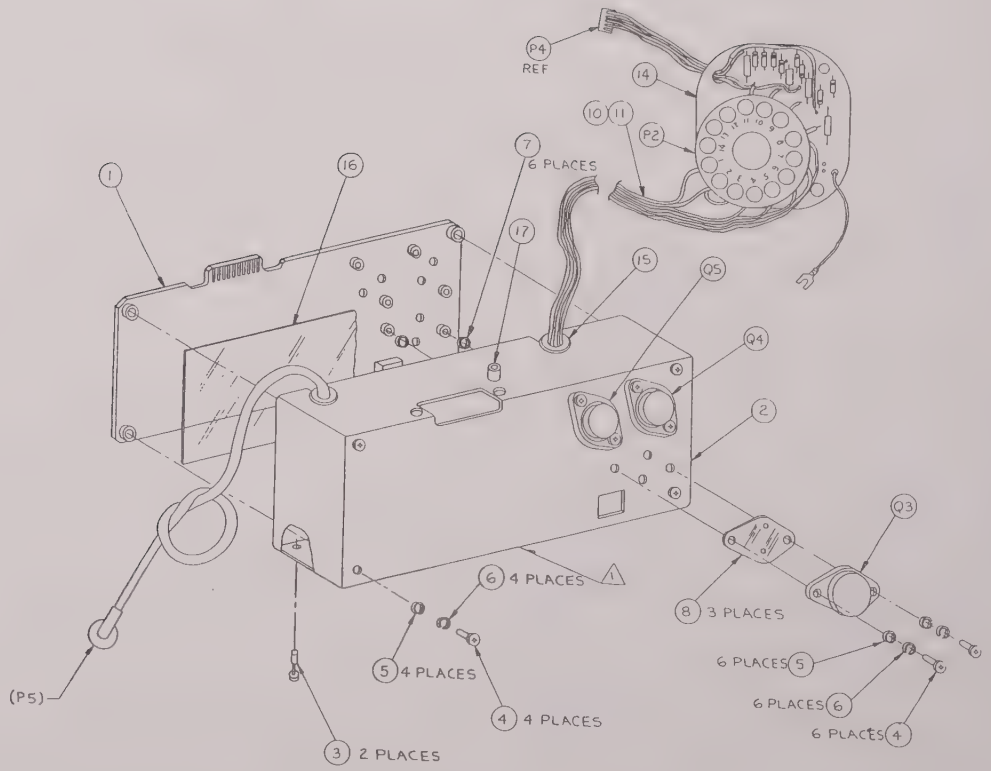
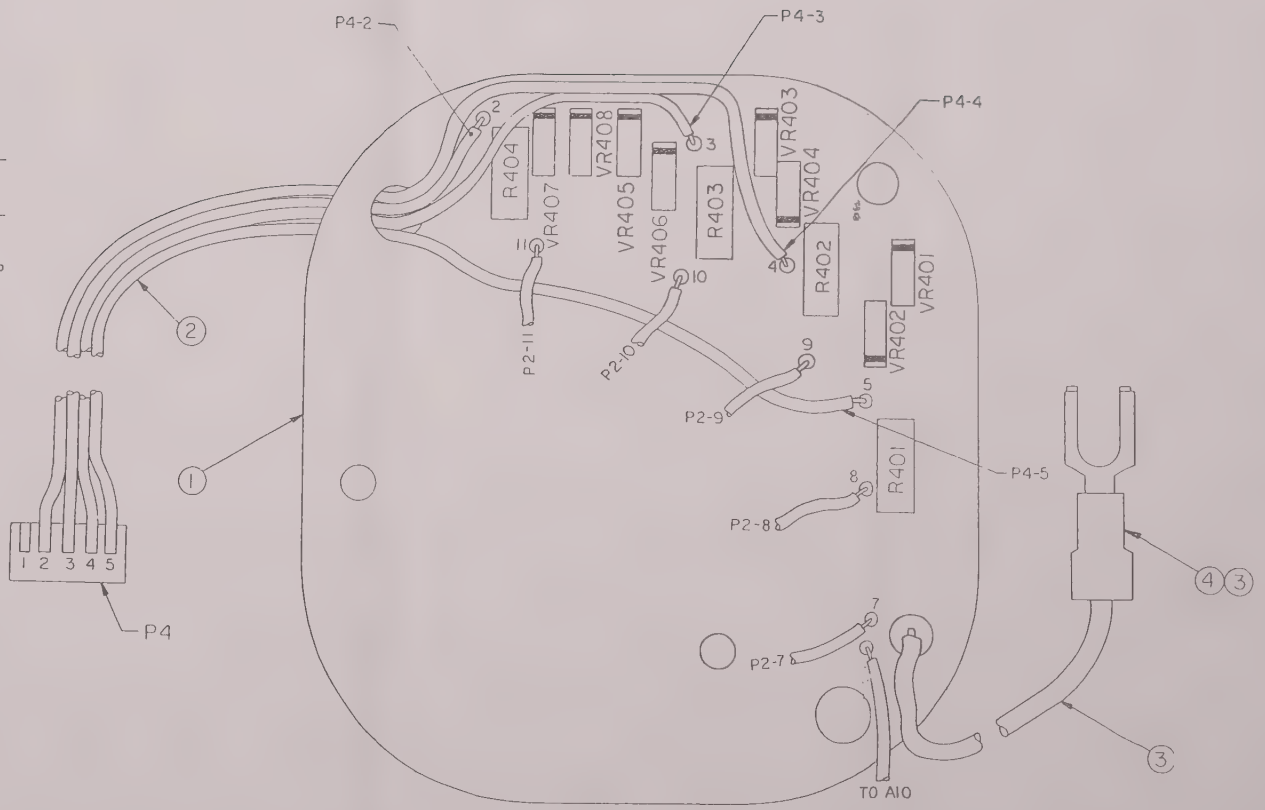


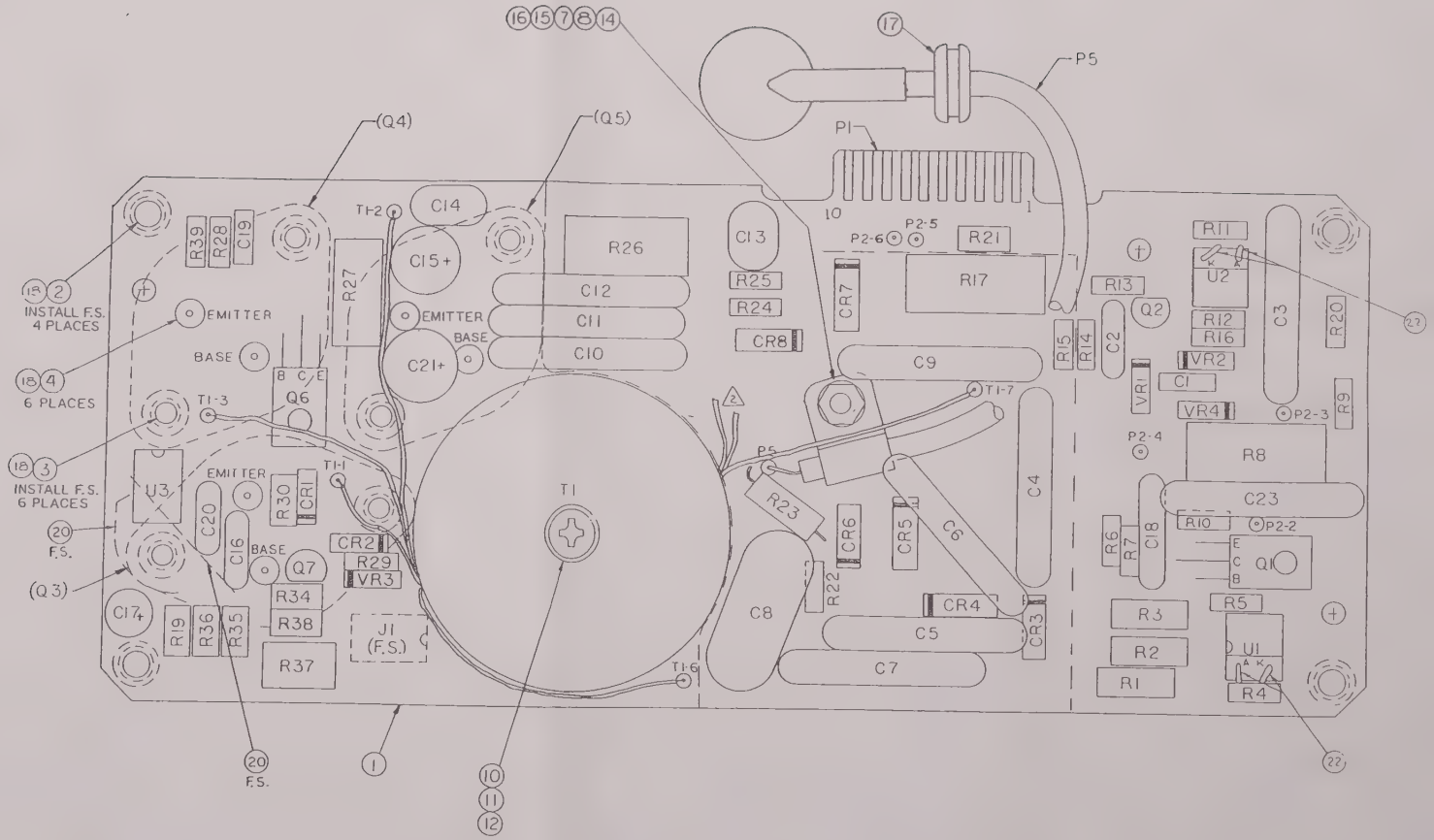

Figure 16-3. High Voltage Power Supply A10 (RTP-1006A) Parts Location Diagram

| Find No. | Qty. Req. | Part No. | Nomenclature | Part Value |
|---|---|---|---|---|
| 001 | 1 | 84-P01332V001 | PRINTED WIRING BOA | TRANSIENT PROTECTO |
| 002 | AR | | WIRE | #22 WHT |
| 003 | AR | | WIRE | #16 WHT |
| 004 | 1 | 601SL | TERMINAL,LUG | |
| 005 | AR | SN63WRP3 | SOLDER | |
| 006 | AR | MS3367-4-9 | STRAP,TIEDOWN | |
| P 004 | 1 | 640440-5 | CONNECTOR,5 PIN | 5 PIN |
| R 401 | 1 | 06-125A49 | RESISTOR | 1000-5-1/2 |
| R 402 | 1 | 06-125A49 | RESISTOR | 1000-5-1/2 |
| R 403 | 1 | 06-125A49 | RESISTOR | 1000-5-1/2 |
| R 404 | 1 | 06-125A49 | RESISTOR | 1000-5-1/2 |
| VR401 | 1 | 48-80368A95 | DIODE,ZENER | 120V |
| VR402 | 1 | 48-80368A95 | DIODE,ZENER | 120V |
| VR403 | 1 | 48-80368A95 | DIODE,ZENER | 120V |
| VR404 | 1 | 48-80368A95 | DIODE,ZENER | 120V |
| 405 | 1 | 48-80368A95 | DIODE,ZENER | 120V |
| 406 | 1 | 48-80368A95 | DIODE,ZENER | 120V |
| VR407 | 1 | 48-80368A95 | DIODE,ZENER | 120V |
| VR408 | 1 | 48-80368A95 | DIODE,ZENER | 120V |




1-80304A60

Figure 16-4. Communications System Analyzer Transient Protector Assembly Parts Location Diagram




RTP-4015A

Figure 16-5. High Voltage Power Supply A10 PWB Parts Location Diagram (Sheet 1 of 2)

| Find No. | Qty. Req. | Part No. | Nomenclature | Part Value |
|---|---|---|---|---|
| | | RTP-4015A | HIGH VOLT PWR SUP | |
| 001 | 1 | 84-P07879V001 | PRINTED WIRING BOA | |
| 002 | 4 | B1534-B-1/8-5 | SPACER,SWAGE | .125LG |
| 003 | 6 | B1534-B-3/32-5 | SPACER,SWAGE | .093LG |
| 004 | 6 | 640206-1 | JACK,PRINTED CIRCU | |
| 007 | 1 | MS35206-217 | SCREW,PH | .1120-40X.500 |
| 008 | 1 | 02-7019 | NUT | .1120-40 |
| 010 | 1 | MS35206-329 | SCREW | .1380-32X1.375 |
| 011 | 1 | MS27183-5 | WASHER,FL | .156 |
| 012 | 1 | KF2 632 | NUT,CLINCH | 6-32 |
| 014 | 1 | 42-15031A60 | CLAMP,LOOP NYLON | |
| 015 | 1 | 04-7607 | WASHER,FLAT | .125 |
| 016 | 1 | 04-114583 | WASHER,LOCK | .112 |
| 017 | 1 | MS35489-4 | GROMMET,RUBBER | |
| 018 | AR | SN63WRP3 | SOLDER | |
| 019 | AR | 11-14167A01 | INK | BLACK |
| 020 | AR | | WIRE,SOLID | #26 WHT |
| 021 | AR | RTV3140 | COATING,SILICONE | |
| 022 | AR | | INSULATION SLEEVIN | #24 WHT |
| C 001 | 1 | 21-80369A82 | CAPACITOR | .1UF-20-100 |
| C 002 | 1 | 21-80396A52 | CAPACITOR | .01UF-20+80-200 |
| C 003 | 1 | 21D83596E19 | CAPACITOR | .01UF+80-20-3KV |
| C 004 | 1 | 21D83596E19 | CAPACITOR | .01UF+80-20-3KV |
| C 005 | 1 | 21D83596E19 | CAPACITOR | .01UF+80-20-3KV |
| C 006 | 1 | 21D83596E19 | CAPACITOR | .01UF+80-20-3KV |
| C 007 | 1 | 21D83596E19 | CAPACITOR | .01UF+80-20-3KV |
| C 008 | 1 | 21-80369A80 | CAPACITOR | .0047-6000 |
| C 009 | 1 | 21D83596E19 | CAPACITOR | .01UF+80-20-3KV |
| C 010 | 1 | 21D83596E19 | CAPACITOR | .01UF+80-20-3KV |
| C 011 | 1 | 21D83596E19 | CAPACITOR | .01UF+80-20-3KV |
| C 012 | 1 | 21D83596E19 | CAPACITOR | .01UF+80-20-3KV |
| C 013 | 1 | 21-80370A30 | CAPACITOR | 82PF-3KV |
| C 014 | 1 | 21-80396A51 | CAPACITOR | 1000PF-10-100 |
| C 015 | 1 | 23-80369A79 | CAPACITOR | 47UF-50V |
| C 016 | 1 | 21D82428B36 | CAPACITOR | 2000PF-10-200 |
| C 017 | 1 | 23-80396A40 | CAPACITOR | 10UF-25V |
| C 018 | 1 | 21D82428B19 | CAPACITOR | .01UF-20-500 |
| C 019 | 1 | 21-80369A82 | CAPACITOR | .1UF-20-100 |
| C 020 | 1 | 21-80369A82 | CAPACITOR | .1UF-20-100 |
| C 021 | 1 | 23-80369A73 | CAPACITOR | 100UF-35V |
| C 023 | 1 | 21D83596E19 | CAPACITOR | .01MF-3KV |
| CR001 | 1 | 48-84463K02 | DIODE | |
| CR002 | 1 | 48-84463K02 | DIODE | |
| CR003 | 1 | 48-80345A63 | DIODE | |
| CR004 | 1 | 48-80345A63 | DIODE | |
| CR005 | 1 | 48-80345A63 | DIODE | |
| CR006 | 1 | 48-80345A63 | DIODE | |
| CR007 | 1 | 48-80345A63 | DIODE | |
| CR008 | 1 | 48-80345A63 | DIODE | |
| J 001 | 1 | 09-80331A95 | SOCKET,SOLDER DIP | 8 PIN |
| P 005 | 1 | 01-80350A53 | LEAD ASSEMBLY,HV | |
| Q 001 | 1 | 48-80341A45 | TRANSISTOR | |
| Q 002 | 1 | 48-80341A46 | TRANSISTOR | MPS-D51 SCREENED |
| Q 006 | 1 | 48-80368A87 | TRANSISTOR | |

| Find No. | Qty. Req. | Part No. | Nomenclature | Part Value |
|---|---|---|---|---|
| Q 007 | 1 | 48-80368A92 | TRANSISTOR | MPS6519 SCREENED |
| R 001 | 1 | 6S125B24 | RESISTOR | 1.2M-5-1/2 |
| R 002 | 1 | 6S125B22 | RESISTOR | 1M-5-1/2 |
| R 003 | 1 | 6S125B24 | RESISTOR | 1.2M-5-1/2 |
| R 004 | 1 | 6S124A29 | RESISTOR | 150-5-1/4 |
| R 005 | 1 | 6S124B18 | RESISTOR | 680K-5-1/4 |
| R 006 | 1 | 6S124B22 | RESISTOR | 1M-5-1/4 |
| R 007 | 1 | 6S124B22 | RESISTOR | 1M-5-1/4 |
| R 008 | 1 | 6-80331A37 | RESISTOR | 20M-1-1 |
| R 009 | 1 | 6S124A97 | RESISTOR | 100K-5-1/4 |
| R 010 | 1 | 6S124A89 | RESISTOR | 47K-5-1/4 |
| R 011 | 1 | 6S124A29 | RESISTOR | 150-5-1/4 |
| R 012 | 1 | 6S124A97 | RESISTOR | 100K-5-1/4 |
| R 013 | 1 | 6S124A97 | RESISTOR | 100K-5-1/4 |
| R 014 | 1 | 6S124B16 | RESISTOR | 560K-5-1/4 |
| R 015 | 1 | 6S124A97 | RESISTOR | 100K-5-1/4 |
| R 016 | 1 | 6S124B22 | RESISTOR | 1M-5-1/4 |
| R 017 | 1 | 6-80331A37 | RESISTOR | 20M-1-1 |
| R 019 | 1 | 06-10621E48 | RESISTOR | 412K-1-1/8 |
| R 020 | 1 | 6S124B22 | RESISTOR | 1M-5-1/4 |
| R 021 | 1 | 06-10621D52 | RESISTOR | 42.2K-1-1/8 |
| R 022 | 1 | 6S124A73 | RESISTOR | 10K-5-1/4 |
| R 023 | 1 | 6S125B22 | RESISTOR | 1M-5-1/2 |
| R 024 | 1 | 6S124A73 | RESISTOR | 10K-5-1/4 |
| R 025 | 1 | 6S124A73 | RESISTOR | 10K-5-1/4 |
| R 026 | 1 | 6-80331A37 | RESISTOR | 20M-1-1 |
| R 027 | 1 | 6S126A25 | RESISTOR | 100-5-1 |
| R 028 | 1 | 6S124A01 | RESISTOR | 10-5-1/4 |
| R 029 | 1 | 6S124A71 | RESISTOR | 8.2K-5-1/4 |
| R 030 | 1 | 06-10621A81 | RESISTOR | 68.1-1-1/8 |
| R 034 | 1 | 06-10621C91 | RESISTOR | 10K-1-1/8 |
| R 035 | 1 | 06-10621C93 | RESISTOR | 10.5K-1-1/8 |
| R 036 | 1 | 06-10621E85 | RESISTOR | 1M-1-1/8 |
| R 037 | 1 | 18083452F33 | RESISTOR,VARIABLE | 20K |
| R 038 | 1 | 06-10621D54 | RESISTOR | 44.2K-1-1/8 |
| R 039 | 1 | 6S124A49 | RESISTOR | 1K-5-1/4 |
| T 001 | 1 | 25-80369A13 | TRANSFORMER | |
| U 001 | 1 | 51-P07938V002 | INTEGRATED CIRCUIT | OP120 SCREENED |
| U 002 | 1 | 51-P07938V002 | INTEGRATED CIRCUIT | OP120 SCREENED |
| U 003 | 1 | 51-80345A02 | INTEGRATED CIRCUIT | CA3160E SCREENED |
| VR001 | 1 | 48-80345A86 | DIODE,ZENER | 87V-5-.5 |
| VR002 | 1 | 48-80345A87 | DIODE,ZENER | 150V-5-.5 |
| VR003 | 1 | 48-80368A98 | DIODE,ZENER | 6.2V-5-.4 |
| VR004 | 1 | 48-83461E13 | DIODE,ZENER | |

RTP-4015 A

Figure 16-5. High Voltage Power Supply A10 PWB Parts Location Diagram (Sheet 2 of 2)

# SECTION 17
# RF INPUT MODULE (A11)

**17-1. General.** The RF Input Module is subdivided into three isolated circuits; input protection and power meter, wideband amplifier and frequency converter, and duplex generator. A block diagram of the RF Input Module is shown in figure 17-1 with its schematic shown in figure 17-2.

**17-2. Input Protection and Power Meter.** RF power to and from the system pass through this section to a common input/output RF connector (RF In/Out) attached to the module. In the generate or monitor operating modes the input protection relay is switched so that a low-loss 50-ohm path exists through the module. When the power monitor mode is selected, the WATT MTR EN line switches the relay so that the input is connected to a 50 ohm power termination. A detector across a portion of the load provides a DC level proportional to the input RF level. This level is amplified and made available to the system processor for the determination of input power. A terminal sensor monitors the load temperature and signals the processor when safe operating limits are exceeded. The processor in turn warns the operator that the RF input to the unit must be removed to prevent permanent damage.

17-3. If power in excess of 200 mW is applied to the system while operating in either the generate or monitor mode, the input is automatically switched to the 50 ohm load termination to protect the system. A signal line (INPUT PROTECT ACT) to the processor results in an audible and visual warning to the operator that the unit is in a protected mode. The warning ceases and normal operation resumes if the RF input is removed or if the power monitor mode is selected.

**17-4. Wideband Amplifier and Frequency Converter.** The wideband amplifier provides a leveled RF output from −3 dBm to +13 dBm in the generate mode and a +7 dBm LO drive in the monitor modes over the 10 KHz to 1 GHz frequency range. Primary components of the leveling loop are; the input VCA (Voltage Controlled Attenuator), the output level detector, and the level comparator. A level control voltage, proportional to the desired output level is compared to the actual output level as determined by the level detector. The result of the comparison steers the VCA maintaining the detected output level equal to the requested output level. In the generate mode the control voltage is obtained from the front panel RF level control (AM Mod + DC REF). For generate AM, the modulation signal is summed with the DC control level, causing the RF output level to follow the modulation signal. Also, in the generate mode the signal from the output level detector (CARRIER + MOD LVL) is made available for the determination of RF output power and percent of AM. A fixed reference voltage is switched to the level control input in the monitor modes giving a leveled +7 dBm local oscillator drive.

17-5. The VCA on the wideband amplifier board covers the frequency range from 1 MHz to 1 GHz. For frequencies below 1 MHz, the VCA select circuit clamps the VCA in the minimum position and enables a low frequency VCA in the RF Synthesizer. Coincident with the enabling of the low frequency VCA, the time constant of the output RF level detector is increased assuring proper operation down to 10 kHz.

17-6. The wideband amplifier output is relay switched between the local oscillator port of the input mixer for the monitor and generate DSBSC modes, and the RF attenuator for the generate mode. An RF sample from the mixer local oscillator output terminal, at a nominal level of −20 dBm, is provided to the duplex generator.

17-7. The frequency converter section consists of the input mixer, the first IF amplifier, and IF filters. In the monitor mode the desired signal is converted to 10.7 MHz by the input mixer. A two-pole input filter, IF amplifier, and a four-pole output filter select the 10.7 MHz component at the mixer output. The 10.7 MHz IF output of the converter is applied to the receive module.

17-8. For DSBSC generator the modulation audio is applied to the IF port of the input mixer through an isolation network. With the output of the wideband amplifier switched to the local oscillator port, a DSBSC signal is present at the RF port. Switching the Step Attenuator to the RF output port makes the DSBSC signal available at the RF output.

**17.9. Duplex Generator.** The Duplex Generator output is a frequency component that is offset from the system monitor frequency by 0 to 10 MHz or by 45 MHz. The offset is obtained by mixing the −20 dBm local oscillator signal from the wideband amp, which is already offset by 10.7 MHz, with a signal frequency from 10.7 MHz to 0.7 MHz or 34.3 MHz.

17-10. For the 3433MHz mixing signal, a single VCO is used. Tuning of the VCO is with the OFFSET FINE TUNE line from the front panel. Frequency modulation of the VCO is implemented by summing the OFFSET MOD signal with the tuning voltage.

17-11. For the 0.7 MHz to 10.7 MHz mixing signal a VCO with a frequency range from 35 MHz to 45 MHz is mixed with the 34.3 MHz VCO. The 35-45 MHz VCO is tuned by the OFFSET COARSE TUNE line from the front panel.

17-12. A sample of the offset frequency is made available to the frequency counter on the OFFSET FREQ line. The processor uses the frequency information to calculate and display the actual duplex frequency

CHANGES HAVE BEEN MADE ON THIS PAGE. SEE ISSUE SHEET. 1/24/94

6 NOTES

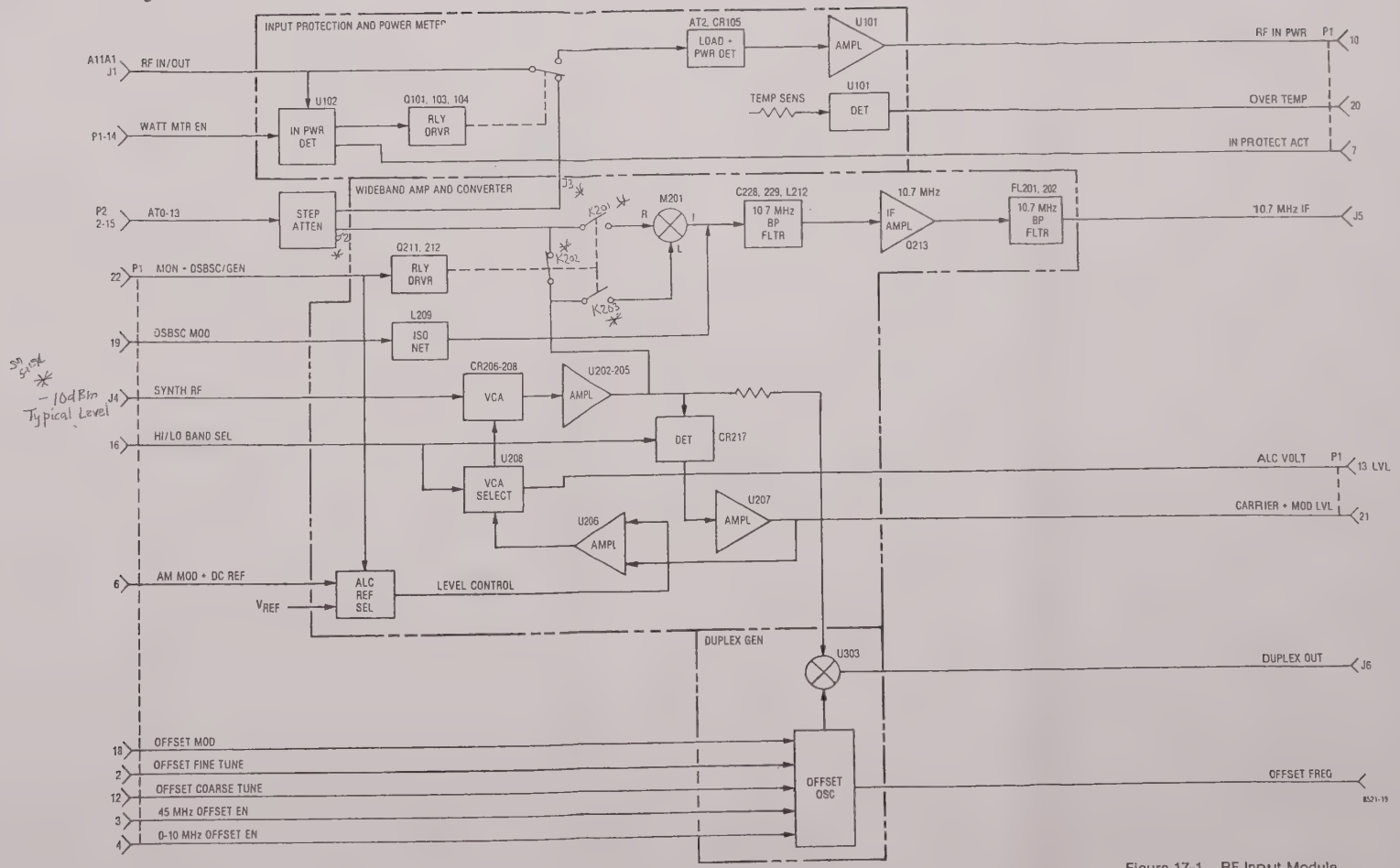



Figure 17-1. RF Input Module A11 Block Diagram

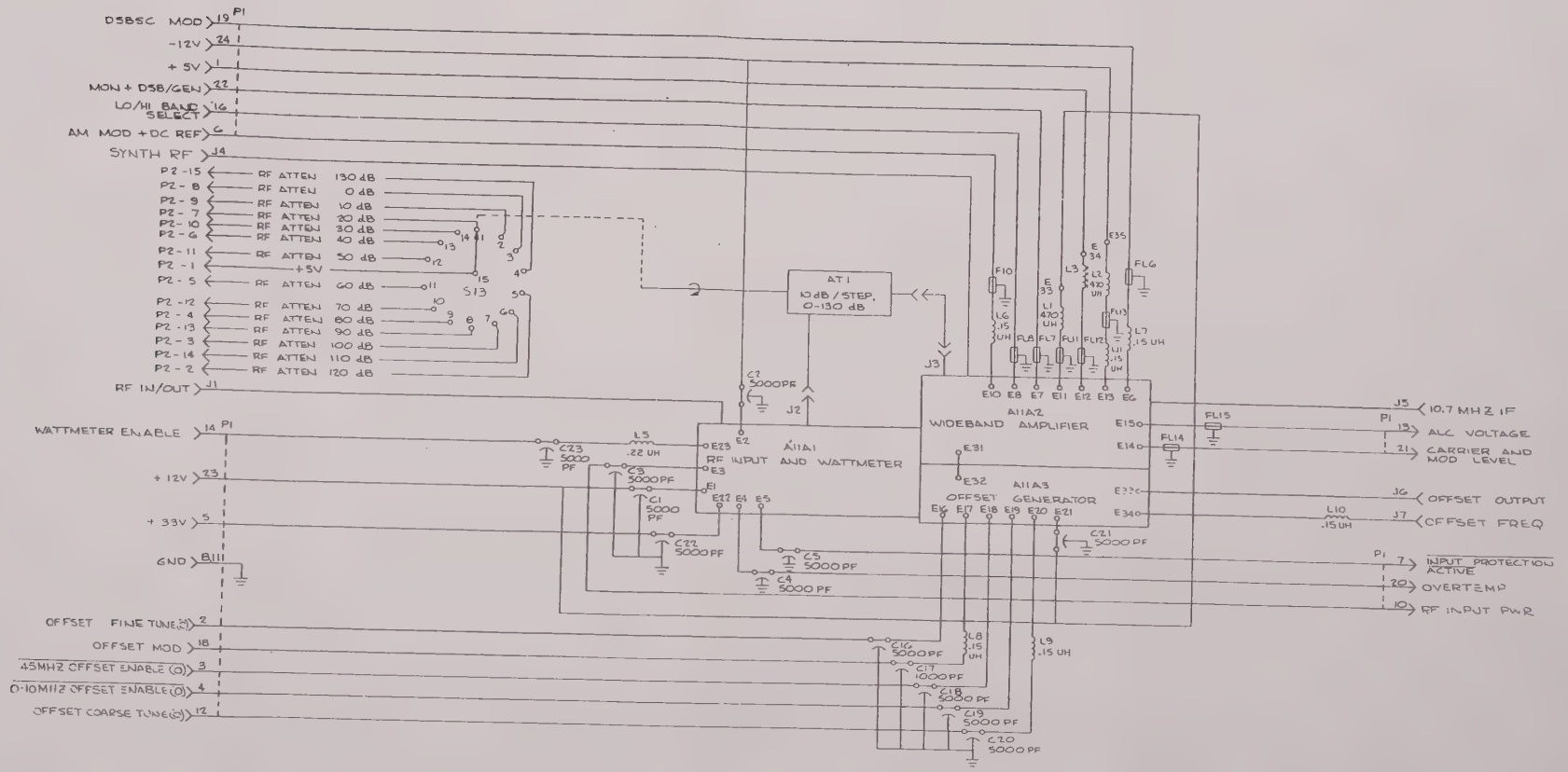



Figure 17-2. RF Input Module A11 Schematic Diagram

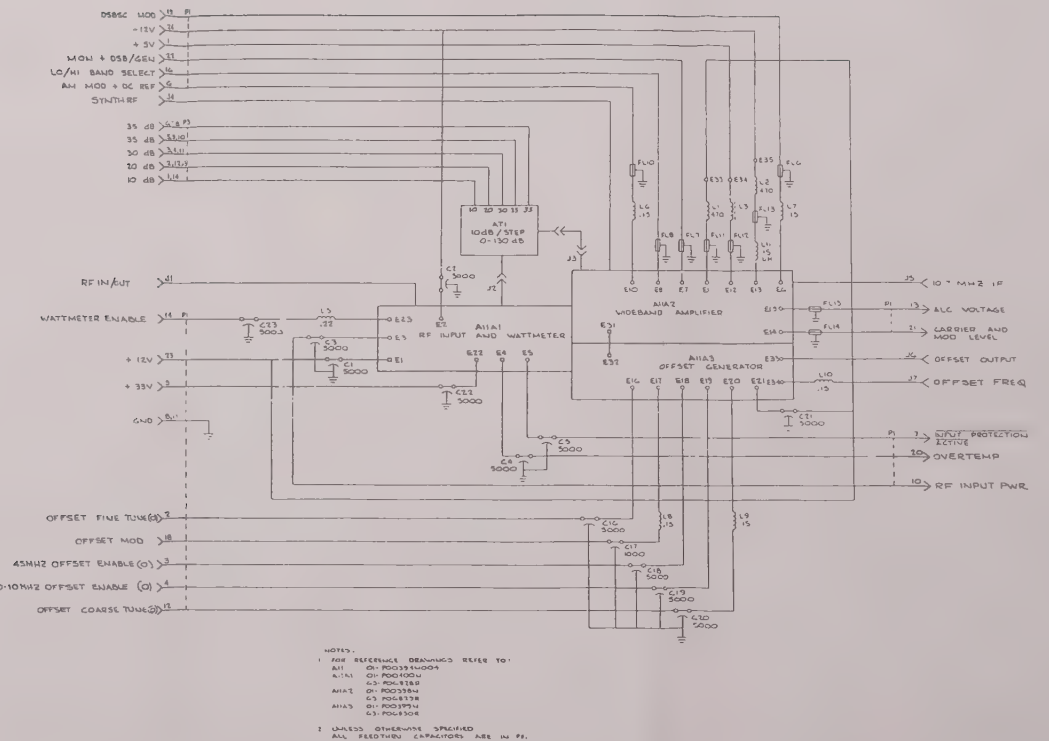



Figure 17-3. RF Input Module A11 with IEEE Option Schematic Diagram

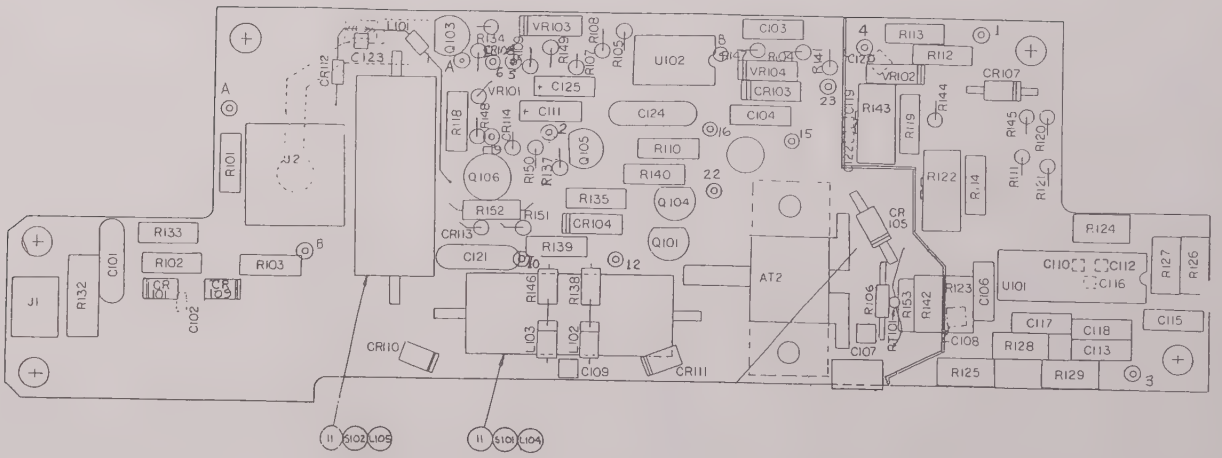
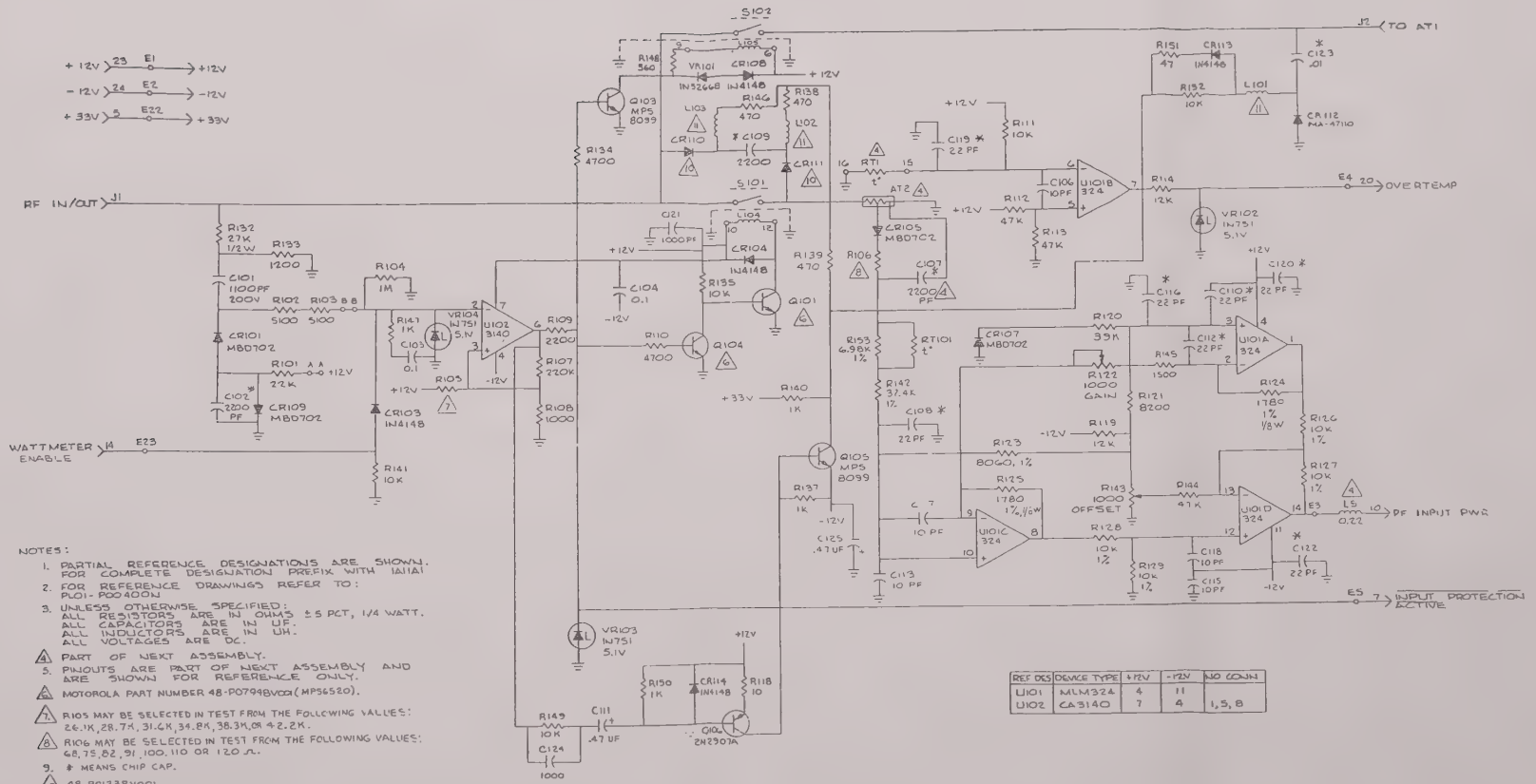



Figure 17-6. RF Input/Wattmeter A11A1 (RTL-4061B) Parts Location Diagram (Sheet 1 of 2)




| REF DES | DEVICE TYPE | +12V | -12V | NO CONN |
|---|---|---|---|---|
| U101 | MLM324 | 4 | 11 | |
| U102 | CA3140 | 7 | 4 | 1, 5, 8 |

Figure 17-5. RF Input/Wattmeter PWB A11A1 Schematic Diagram

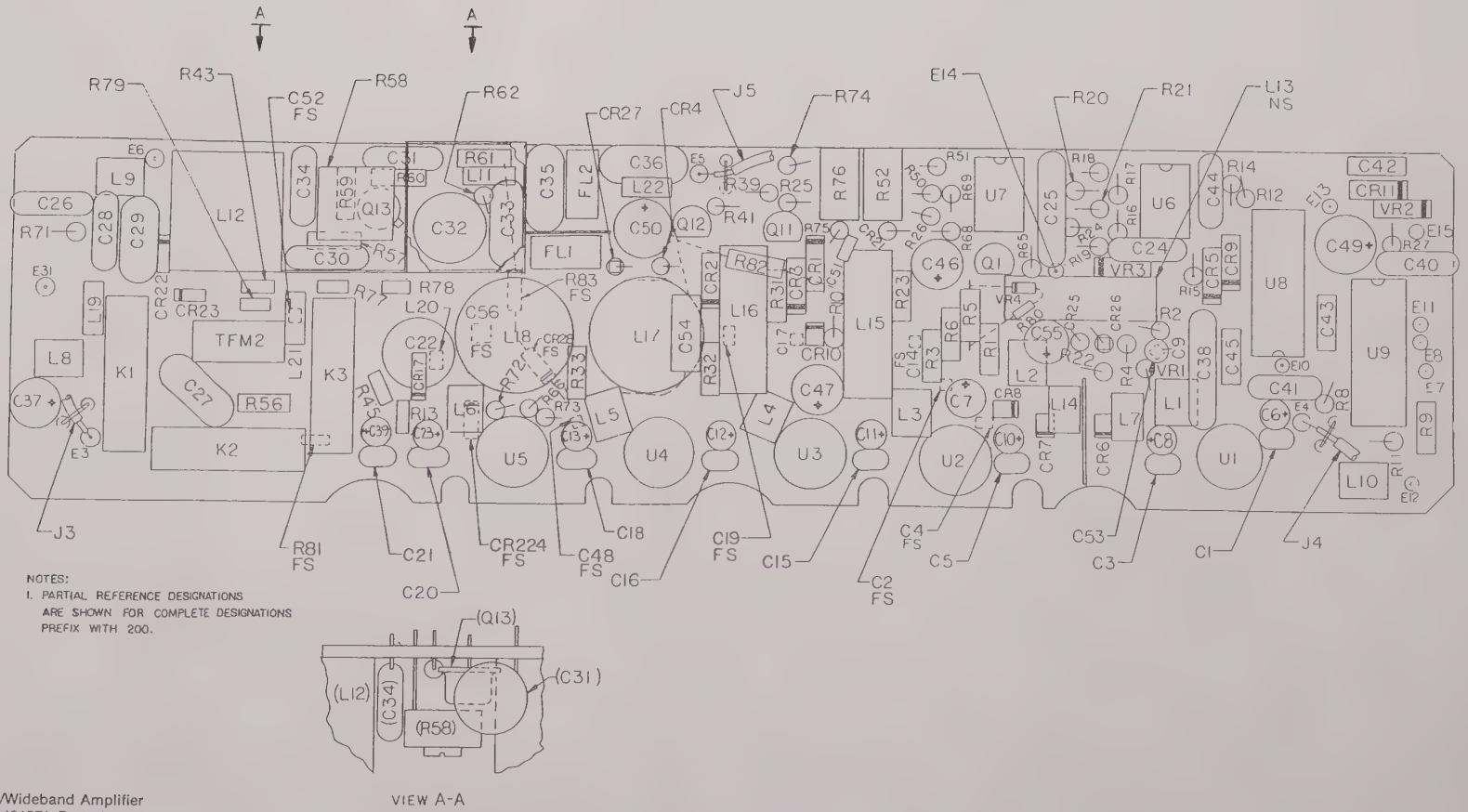
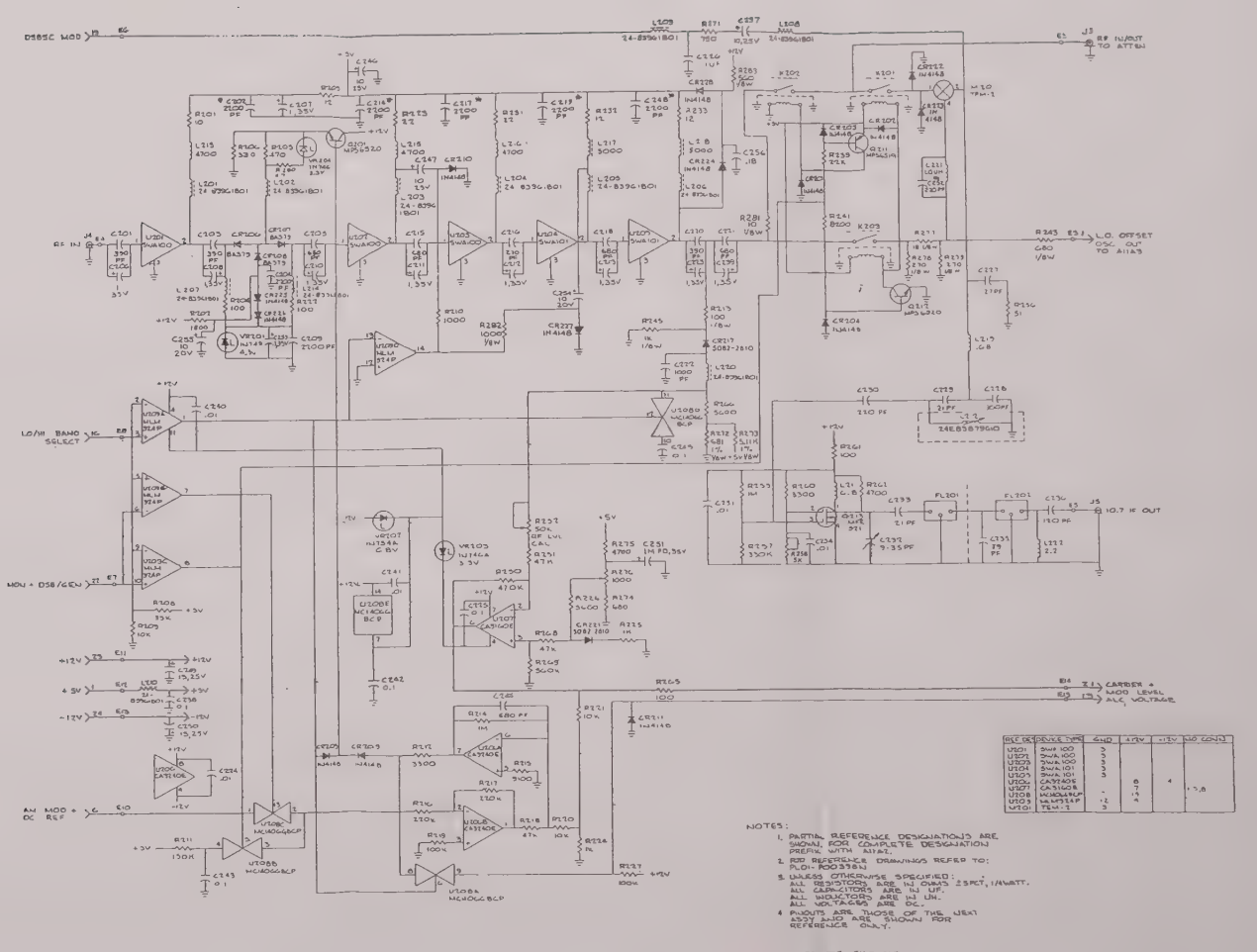



Figure 17-8. RF Converter/Wideband Amplifier A11A2 (RTC-4015B) Parts Location Diagram



| REF DESIGNATION | TYPE | GND | +12V | -12V | I/O CONN |
|---|---|---|---|---|---|
| U201 | 5082-2810 | 3 | | | |
| U202 | 5082-2810 | 3 | | | |
| U203 | 5082-2810 | 3 | | | |
| U204 | 5082-2810 | 3 | | | |
| U205 | 5082-2810 | 3 | | | |
| U206 | CA3140E | | 8 | | |
| U207 | CA3140E | | 7 | | |
| U208 | MC1496BCP | 1 | 14 | | |
| U209 | MC1496BCP | 12 | 4 | | |
| U210 | TEM-2 | 3 | | | |

NOTES:

1. PARTIAL REFERENCE DESIGNATIONS ARE SHOWN FOR COMPLETE DESIGNATION PREFIX WITH A11A2.
2. FOR REFERENCE DRAWINGS REFER TO: A_01-8003861
3. UNLESS OTHERWISE SPECIFIED: ALL RESISTORS ARE IN OHMS 25PCT, 1/4WATT. ALL CAPACITORS ARE IN UF. ALL INDUCTORS ARE IN UH. ALL VOLTAGES ARE DC.
4. PINOUTS ARE THOSE OF THE VERY 8531 AND ARE SHOWN FOR REFERENCE ONLY.
5. # DENOTES CHIP CAP

Figure 17-7. RF Converter/Wideband Amplifier A11A2 Schematic Diagram

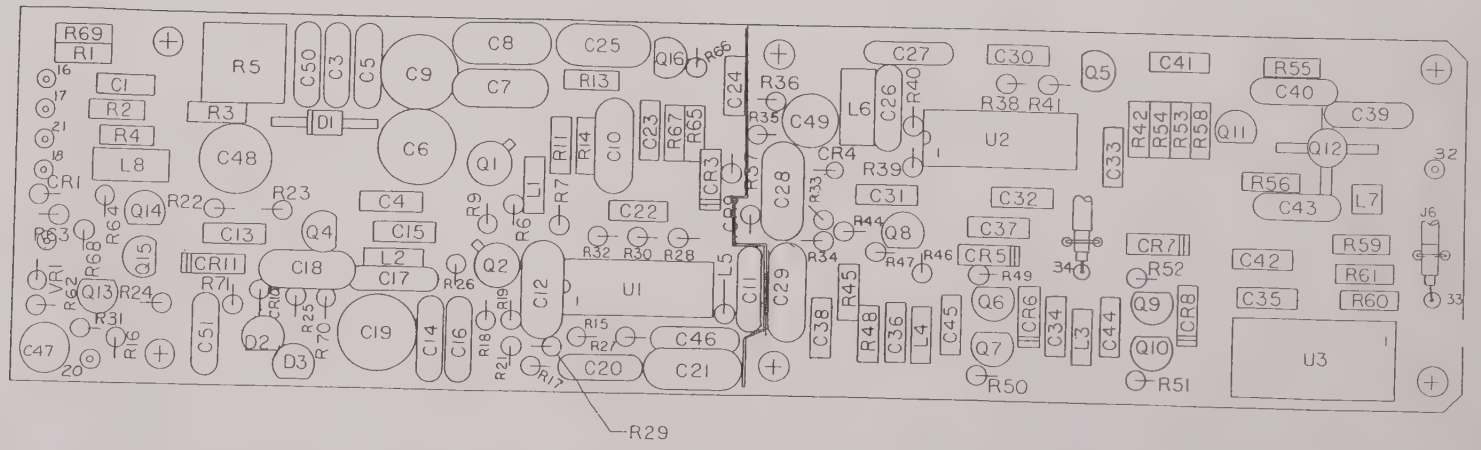
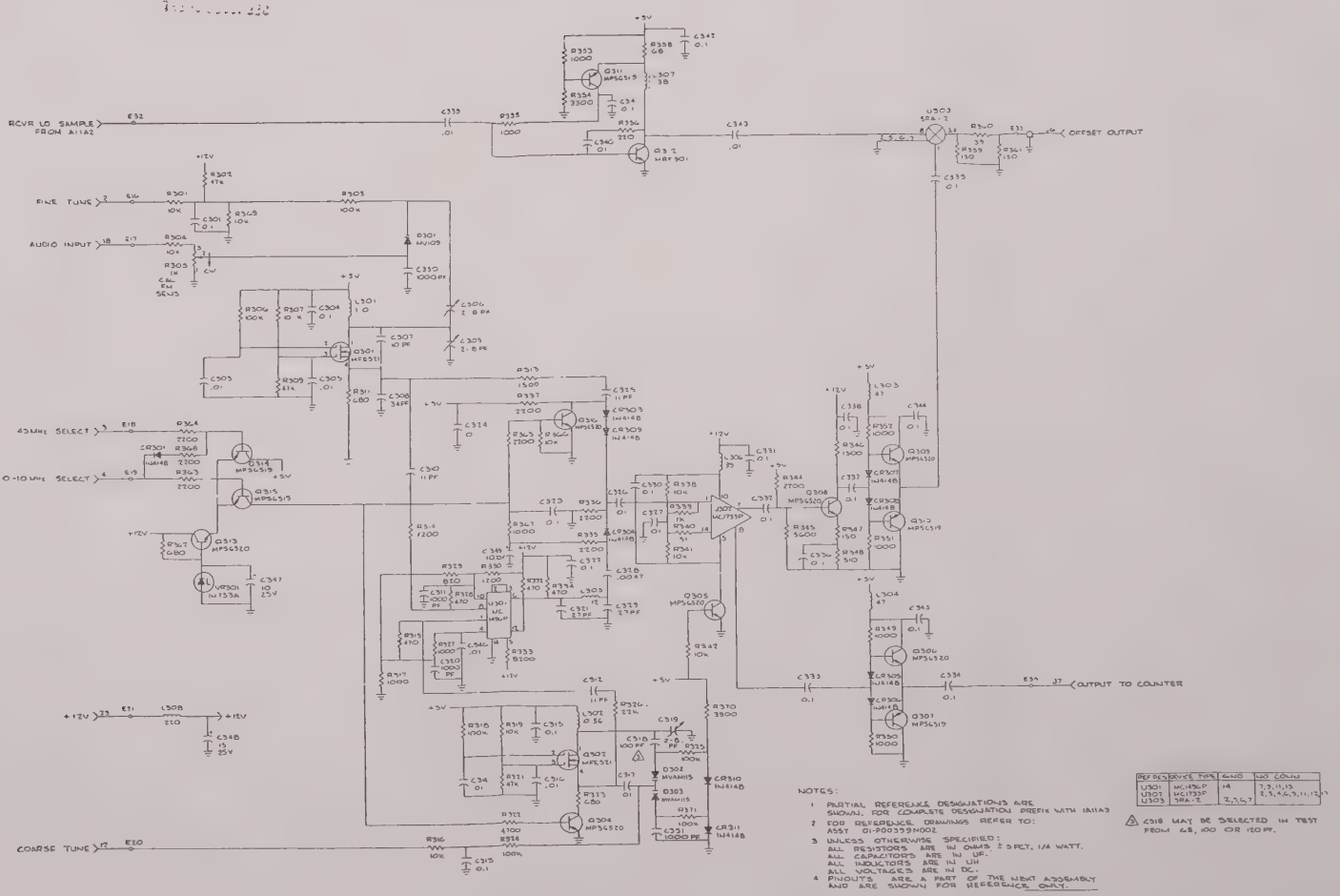



Figure 17-10. Offset Generator A11A3 (RTC-4016B) Parts Location Diagram


RCVR LO SAMPLE FROM A11A2
FINE TUNE
AUDIO INPUT
43 MHz SELECT
0-10 MHz SELECT
COARSE TUNE
+12V
OFFSET OUTPUT
OUTPUT TO COUNTER
NOTES:
1 PARTIAL REFERENCE DESIGNATIONS ARE SHOWN. FOR COMPLETE DESIGNATION PREFIX WITH 11A1A3
2 FOR REFERENCE DRAWINGS REFER TO: ASSY 01-P003939002
3 UNLESS OTHERWISE SPECIFIED: ALL RESISTORS ARE IN OHMS ± 5 PCT, 1/4 WATT. ALL CAPACITORS ARE IN UF. ALL INDUCTORS ARE IN UH ALL VOLTAGES ARE IN DC.
4 PINOUTS ARE A PART OF THE NEXT ASSEMBLY AND ARE SHOWN FOR REFERENCE ONLY.
C318 MAY BE SELECTED IN TEST FROM 68, 100 OR 120 PF.

| REF DES | DEVICE TYPE | GND | +5 V |
|---|---|---|---|
| U301 | MC1496P | 14 | 7, 9, 11, 13 |
| U302 | MC1733P | 8 | 2, 5, 4, 6, 9, 11, 12 |
| U303 | SRA-1 | 2, 3, 6, 7 | |

Figure 17-9. Offset Generator A11A3 Schematic Diagram

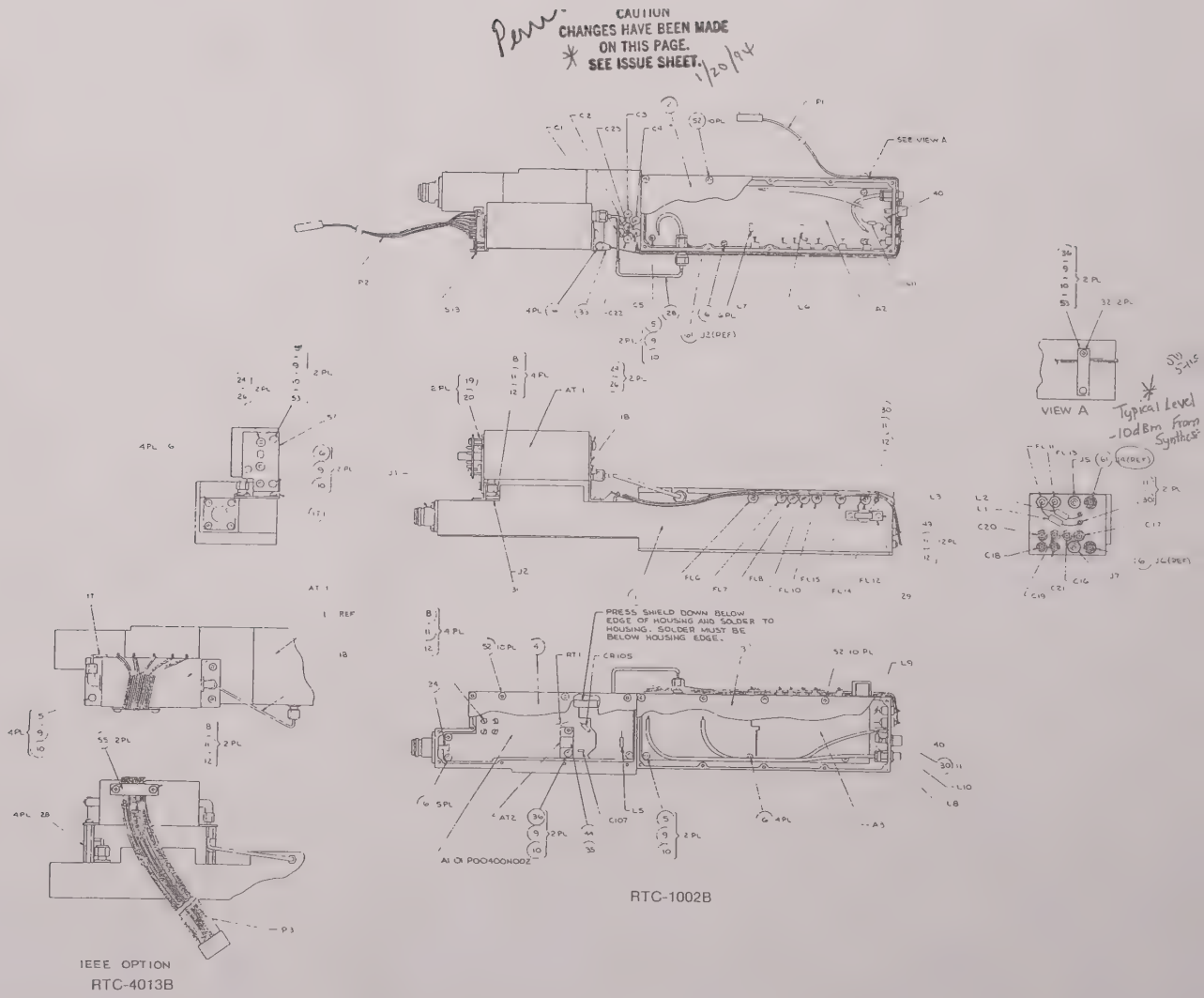



Figure 17-4. RF Input Module A11 (RTC-1002B)
Parts Location Diagram
(Sheet 1 of 2)

| Find No. | Qty. Req. | Part No. | Nomenclature | Part Value |
|---|---|---|---|---|
| 001 | 1 | 84-80335A19 | PWB,RF PROTECTION | |
| 002 | AR | SN63WRMAP3 | SOLDER | |
| 003 | AR | SN63WRP3 | SOLDER | |
| 004 | AR | SN62WRMAP3 | SOLDER | |
| 005 | AR | 11-14167A01 | INK | BLACK |
| 007 | 1 | 26-P00347N001 | SHIELD,RF FENCE CH | |
| 008 | AR | | WIRE | #24 WHT |
| 009 | AR | M23053/5-106-9 | INSULATION SLEEVIN | .250 WHT |
| 010 | AR | 01-P00400N010 | STRAP,ALLOY 110 CO | .002 THICK,QQ-C-57 |
| 011 | 2 | 39-P00219N001 | SLEEVE | |
| 012 | AR | | INSULATION SLEEVIN | #24 WHT |
| 013 | AR | | WIRE | #22 WHT |
| 014 | AR | | INSULATION SLEEVIN | #22 WHT |
| C 101 | 1 | 21D83596E32 | CAPACITOR | 1100PF-5-200 |
| C 102 | 1 | 21-80370A24 | CAPACITOR | 2200PF-20-100 |
| C 103 | 1 | 21-80396A49 | CAPACITOR | .1UF-20-100 |
| C 104 | 1 | 21-80396A49 | CAPACITOR | .1UF-20-100 |
| C 106 | 1 | 21-80348A96 | CAPACITOR | 10PF-10-100 |
| C 108 | 1 | 21-80370A14 | CAPACITOR | 22PF-5-100 |
| C 109 | 1 | 21-80370A24 | CAPACITOR | 2200PF-20-100 |
| C 110 | 1 | 21-80370A14 | CAPACITOR | 22PF-5-100 |
| C 111 | 1 | 23D84762H14 | CAPACITOR | .47UF-20-50 |
| C 112 | 1 | 21-80370A14 | CAPACITOR | 22PF-5-100 |
| C 113 | 1 | 21-80348A96 | CAPACITOR | 10PF-10-100 |
| C 115 | 1 | 21-80348A96 | CAPACITOR | 10PF-10-100 |
| C 116 | 1 | 21-80370A14 | CAPACITOR | 22PF-5-100 |
| C 117 | 1 | 21-80348A96 | CAPACITOR | 10PF-10-100 |
| C 118 | 1 | 21-80348A96 | CAPACITOR | 10PF-10-100 |
| C 119 | 1 | 21-80370A14 | CAPACITOR | 22PF-5-100 |
| C 120 | 1 | 21-80370A14 | CAPACITOR | 22PF-5-100 |
| C 121 | 1 | 21-80396A51 | CAPACITOR | 1000PF-10-100 |
| C 122 | 1 | 21-80370A14 | CAPACITOR | 22PF-5-100 |
| C 123 | 1 | 21-80370A26 | CAPACITOR | .01UF-20-50 |
| C 124 | 1 | 21-80396A51 | CAPACITOR | 1000PF-10-100 |
| C 125 | 1 | 23D84762H14 | CAPACITOR | .47UF-20-50 |
| C 126 | 1 | 21-80369A94 | CAPACITOR | 150PF-5-500 |
| C 127 | 1 | 21-80396A48 | CAPACITOR | 100PF-10-100 |
| CR101 | 1 | 48-80345A64 | DIODE | |
| CR103 | 1 | 48-84463K02 | DIODE | |
| CR104 | 1 | 48-84463K02 | DIODE | |
| CR107 | 1 | 48-80345A64 | DIODE | |
| CR108 | 1 | 48-84463K02 | DIODE | |
| CR109 | 1 | 48-80345A64 | DIODE | |
| CR110 | 1 | 48-80368A96 | DIODE | |
| CR111 | 1 | 48-80368A96 | DIODE | |
| CR112 | 1 | 48-80345A65 | DIODE | |
| CR113 | 1 | 48-84463K02 | DIODE | |
| CR114 | 1 | 48-84463K02 | DIODE | |
| L 101 | 1 | 24C83961B01 | CHOKE | |
| L 102 | 1 | 24C83961B01 | CHOKE | |
| L 103 | 1 | 24C83961B01 | CHOKE | |
| L 104 | 1 | 24-80369A45 | COIL,RELAY | |
| L 105 | 1 | 24-80369A45 | COIL,RELAY | |

| Find No. | Qty. Req. | Part No. | Nomenclature | Part Value |
|---|---|---|---|---|
| Q 101 | 1 | 48-80368A91 | TRANSISTOR | MPS6520 SCREENED |
| Q 103 | 1 | 48-80345A51 | TRANSISTOR | |
| Q 104 | 1 | 48-80368A91 | TRANSISTOR | MPS6520 SCREENED |
| Q 105 | 1 | 48-80345A51 | TRANSISTOR | |
| Q 106 | 1 | 48-6123A22 | TRANSISTOR | |
| R 101 | 1 | 6S124A81 | RESISTOR | 22K-5-1/4 |
| R 102 | 1 | 6S124A66 | RESISTOR | 5.1K-5-1/4 |
| R 103 | 1 | 6S124A66 | RESISTOR | 5.1K-5-1/4 |
| R 104 | 1 | 6S124B22 | RESISTOR | 1M-5-1/4 |
| R 105 | S01 | 06-10621D44 | RESISTOR | 34.8K-1-1/8 |
| R 105 | S01 | 06-10621D32 | RESISTOR | 26.1K-1-1/8 |
| R 105 | S01 | 06-10621D36 | RESISTOR | 28.7K-1-1/8 |
| R 105 | 1 | 06-10621D40 | RESISTOR | 31.6K-1-1/8 NOMINA |
| R 105 | S01 | 06-10621D48 | RESISTOR | 38.3K-1-1/8 |
| R 105 | S01 | 06-10621D52 | RESISTOR | 42.2K-1-1/8 |
| R 106 | 1 | 6S124A25 | RESISTOR | 100-5-1/4 NOMINAL |
| R 106 | S01 | 6S124A21 | RESISTOR | 68-5-1/4 |
| R 106 | S01 | 6S124A22 | RESISTOR | 75-5-1/4 |
| R 106 | S01 | 6S124A23 | RESISTOR | 82-5-1/4 |
| R 106 | S01 | 6S124A24 | RESISTOR | 91-5-1/4 |
| R 106 | S01 | 6S124A26 | RESISTOR | 110-5-1/4 |
| R 106 | S01 | 6S124A27 | RESISTOR | 120-5-1/4 |
| R 107 | 1 | 6S124B06 | RESISTOR | 220K-5-1/4 |
| R 108 | 1 | 6S124A49 | RESISTOR | 1K-5-1/4 |
| R 109 | 1 | 6S124A57 | RESISTOR | 2.2K-5-1/4 |
| R 110 | 1 | 6S124A65 | RESISTOR | 4.7K-5-1/4 |
| R 111 | 1 | 6S124A73 | RESISTOR | 10K-5-1/4 |
| R 112 | 1 | 6S124A89 | RESISTOR | 47K-5-1/4 |
| R 113 | 1 | 6S124A89 | RESISTOR | 47K-5-1/4 |
| R 114 | 1 | 6S124A75 | RESISTOR | 12K-5-1/4 |
| R 118 | 1 | 6S124A01 | RESISTOR | 10-5-1/4 |
| R 119 | 1 | 6S124A75 | RESISTOR | 12K-5-1/4 |
| R 120 | 1 | 6S124A87 | RESISTOR | 39K-5-1/4 |
| R 121 | 1 | 6S124A71 | RESISTOR | 8.2K-5-1/4 |
| R 122 | 1 | 18D83452F09 | RESISTOR,VARIABLE | 1K |
| R 123 | 1 | 06D83175C90 | RESISTOR | 8.06K-1-1/4 |
| R 124 | 1 | 06-10621C19 | RESISTOR | 1780-1-1/8 |
| R 125 | 1 | 06-10621C19 | RESISTOR | 1780-1-1/8 |
| R 126 | 1 | 06D83175C03 | RESISTOR | 10K-1-1/4 |
| R 127 | 1 | 06D83175C03 | RESISTOR | 10K-1-1/4 |
| R 128 | 1 | 06D83175C03 | RESISTOR | 10K-1-1/4 |
| R 129 | 1 | 06D83175C03 | RESISTOR | 10K-1-1/4 |
| R 132 | 1 | 6S125A83 | RESISTOR | 27K-5-1/2 |
| R 133 | 1 | 6S124A51 | RESISTOR | 1.2K-5-1/4 |
| R 134 | 1 | 6S124A65 | RESISTOR | 4.7K-5-1/4 |
| R 135 | 1 | 6S124A73 | RESISTOR | 10K-5-1/4 |
| R 137 | 1 | 6S124A49 | RESISTOR | 1K-5-1/4 |
| R 138 | 1 | 6S124A41 | RESISTOR | 470-5-1/4 |
| R 139 | 1 | 6S124A41 | RESISTOR | 470-5-1/4 |
| R 140 | 1 | 6S124A49 | RESISTOR | 1K-5-1/4 |
| R 141 | 1 | 6S124A73 | RESISTOR | 10K-5-1/4 |
| R 142 | 1 | 06D83175C51 | RESISTOR | 37.4K-1-1/4 |
| R 143 | 1 | 18D83452F09 | RESISTOR,VARIABLE | 1K |

| Find No. | Qty. Req. | Part No. | Nomenclature | Part Value |
|---|---|---|---|---|
| R 144 | 1 | 6S124A89 | RESISTOR | 47K-5-1/4 |
| R 145 | 1 | 6S124A53 | RESISTOR | 1.5K-5-1/4 |
| R 146 | 1 | 6S124A41 | RESISTOR | 470-5-1/4 |
| R 147 | 1 | 6S124A49 | RESISTOR | 1K-5-1/4 |
| R 148 | 1 | 6S124A43 | RESISTOR | 560-5-1/4 |
| R 149 | 1 | 6S124A73 | RESISTOR | 10K-5-1/4 |
| R 150 | 1 | 6S124A49 | RESISTOR | 1K-5-1/4 |
| R 151 | 1 | 6S124A17 | RESISTOR | 47-5-1/4 |
| R 152 | 1 | 6S124A73 | RESISTOR | 10K-5-1/4 |
| R 153 | 1 | 06D83175C88 | RESISTOR | 6.98K-1-1/4 |
| R 154 | 1 | 6S124A25 | RESISTOR | 100-5-1/4 |
| RT101 | 1 | 06C83600K05 | THERMISTOR | |
| S 101 | 1 | 40-84200B02 | SWITCH,RF | |
| S 102 | 1 | 40-84200B02 | SWITCH,RF | |
| U 101 | 1 | 51-80395A16 | INTEGRATED CIRCUIT | LM324N SCREENED |
| U 102 | 1 | 51-80345A01 | INTEGRATED CIRCUIT | CA3140E SCREENED |
| VR101 | 1 | 48-80345A84 | DIODE,ZENER | 68V-5-.5 |
| VR102 | 1 | 48-86850C13 | DIODE,ZENER | 5.1V-5-.4 |
| VR103 | 1 | 48-86850C13 | DIODE,ZENER | 5.1V-5-.4 |
| VR104 | 1 | 48-86850C13 | DIODE,ZENER | 5.1V-5-.4 |

Figure 17-6. RF Input/Wattmeter A11A1 (RTL-4061B) Parts Location Diagram

| Find No. | Qty. Req. | Part No. | Nomenclature | Part Value |
|---|---|---|---|---|
| | | RTC-1002B | RF INPUT MODULE | |
| 001 | 1 | 27-80396A86 | HOUSING,RF FRONT | PLATING REQ |
| 002 | 1 | 15-80346A22 | COVER,MODULE | OFFSET GENERATOR |
| 003 | 1 | 15-80331A83 | COVER,MOD,WIDE-BAN | |
| 004 | 1 | 15-80335A33 | COVER,MODULE-RF | PROTECTION-WATTMET |
| 005 | 8 | 03-136786 | SCREW,PH | .112-40X 250 |
| 006 | 23 | 03-138804 | SCREW,MACH,SEMS PH | .112-40X.312 |
| 007 | AR | | GASKET | .062 |
| 008 | 4 | 03-15013G10 | SCREW,PH | 2-56X 250 |
| 009 | 12 | 04-114583 | WASHER,LOCK | .112 |
| 010 | 12 | 04-7607 | WASHER,FLAT | .125 |
| 011 | 14 | MS35338-39 | WASHER,LOCK | NO.2 |
| 012 | 11 | NAS620C2 | WASHER,FLAT | NO.2 |
| 013 | AR | SN63WRMAP3 | SOLDER | |
| 014 | AR | 11-14167A01 | INK | BLACK |
| 015 | AR | 30-84421F13 | CABLE,RF | WHT |
| 016 | AR | | WIRE | #22 WHT |
| 017 | 1 | 07-P01328V001 | BRACKET,FRONT ATT | |
| 018 | 1 | 07-P00209N001 | BRACKET,REAR ATT | |
| 019 | 2 | 2053-440-SS-20 | SPACER | |
| 020 | 2 | MS24693-S1 | SCREW FH | 4-40X3/16 |
| 024 | 4 | MS35206-226 | SCREW | 6-32X 250 |
| 026 | 4 | MS35338-41 | WASHER,LOCK | NO.6 |
| 027 | AR | 8-2 | EPOXY,ABELSTIK | |
| 028 | 1 | 01-80304A45 | CABLE ASSEMBLY | |
| 029 | 1 | 07-P00318N001 | BRACKET,CHOKE MNTG | |
| 030 | 4 | 29-14070A91 | TERMINAL | |
| 031 | 1 | 43-P06840R001 | SPACER,CONNECTOR | |
| 032 | 2 | 42-P06849R001 | STRAP,CLAMP,CABLE | |
| 033 | 1 | 29-15122A05 | TERMINAL,LUG | |
| 034 | 1 | 29-P06850R001 | TERMINAL,SOLDER | |
| 035 | AR | G-642 | COMPOUND,THERMAL | |
| 036 | 4 | MS35206-215 | SCREW | 4-40X 375 |
| 037 | AR | M23053/5-103-9 | INSULATION SLEEVIN | .093 WHT |
| 038 | AR | M23053/5-106-9 | INSULATION SLEEVIN | .250 WHT |
| 040 | 2 | 813 | TERMINAL LUG NO.12 | .018 BRASS HOT TIN |
| 042 | AR | | WIRE,BUS | #24 |
| 043 | AR | | INSULATION SLEEVIN | #22 WHT |
| 044 | 1 | 26-P00346N001 | SHIELD,AT2 CHEM MI | |
| 047 | AR | SN62WRMAP3 | SOLDER | |
| 048 | AR | | COMPOUND,THO LKG,B | TYPE II GR N#242 |
| 049 | 2 | 03-15013G09 | SCREW | 2-56X 187 |
| 052 | 30 | MS24693-S2 | SCREW | 4-40X1/4 |
| 053 | 2 | 5610-21-31 | WASHER | NO.4 |
| 055 | AR | MS3367-4-9 | STRAP | NATURAL |
| 057 | 1 | 64-P01327V001 | PLATE,FRONT ATTENU | |
| 058 | AR | 11-P14386A001 | ADHESIVE,EPOXY | CHEMLOK 305 |
| 061 | 3 | 1214-05 | WASHER,INT LOCK | 1/4 |
| 062 | AR | M23053/5-204-C | INSULATION SLEEVIN | .125 CLR |
| 064 | 4 | 03-15013G12 | SCREW,PH | 2-56X 375 |
| 065 | 2 | 5607-47 | WASHER,SHOULDER,NY | NO.4 |
| A 001 | 1 | RTL-4061B | RF PROTECTION&POWE | |
| A 002 | 1 | RTC-4015B | RF CONV/WB AMPL PW | |
| A 003 | 1 | RTC-4016B | OFFSET GENERATOR A | |

| Find No. | Qty. Req. | Part No. | Nomenclature | Part Value |
|---|---|---|---|---|
| AT001 | 1 | 58-80335A47 | ATTENUATOR | |
| AT002 | 1 | 58-80348A80 | TERMINATION,RF | 50 OHM |
| C 001 | 1 | 08-80331A29 | CAPACITOR | 5000PF-GMV-500 |
| C 002 | 1 | 08-80331A29 | CAPACITOR | 5000PF-GMV-500 |
| C 003 | 1 | 08-80331A29 | CAPACITOR | 5000PF-GMV-500 |
| C 004 | 1 | 08-80331A29 | CAPACITOR | 5000PF-GMV-500 |
| C 005 | 1 | 08-80331A29 | CAPACITOR | 5000PF-GMV-500 |
| C 016 | 1 | 08-80331A29 | CAPACITOR | 5000PF-GMV-500 |
| C 017 | 1 | 08-80370A38 | CAPACITOR | 1000PF-20-500 |
| C 018 | 1 | 08-80331A29 | CAPACITOR | 5000PF-GMV-500 |
| C 019 | 1 | 08-80331A29 | CAPACITOR | 5000PF-GMV-500 |
| C 020 | 1 | 08-80331A29 | CAPACITOR | 5000PF-GMV-500 |
| C 021 | 1 | 08-80331A29 | CAPACITOR | 5000PF-GMV-500 |
| C 022 | 1 | 08-80331A29 | CAPACITOR | 5000PF-GMV-500 |
| C 023 | 1 | 08-80331A29 | CAPACITOR | 5000PF-GMV-500 |
| C 107 | 1 | 21-80370A08 | CAPACITOR | 2200PF-20-100 |
| CR105 | 1 | 48-80345A64 | DIODE | |
| FL006 | 1 | 91-87679C01 | FILTER | |
| FL007 | 1 | 91-87679C01 | FILTER | |
| FL008 | 1 | 91-87679C01 | FILTER | |
| FL010 | 1 | 91-87679C01 | FILTER | |
| FL011 | 1 | 91-87679C01 | FILTER | |
| FL012 | 1 | 91-87679C01 | FILTER | |
| FL013 | 1 | 91-87679C01 | FILTER | |
| FL014 | 1 | 91-87679C01 | FILTER | |
| FL015 | 1 | 91-87679C01 | FILTER | |
| J 001 | 1 | 09-80331A68 | CONNECTOR,RF | TYPE N |
| J 002 | 1 | 09-80331A76 | CONNECTOR,RF | |
| J 005 | 1 | 9C84135B02 | JACK,PHONO | |
| J 007 | 1 | 9C84135B02 | JACK PHONO | |
| L 001 | 1 | 24-80348A83 | COIL | 470UH |
| L 002 | 1 | 24-80348A83 | COIL | 470UH |
| L 003 | 1 | 25-83127G01 | CHOKE | |
| L 005 | 1 | 24-80369A25 | COIL | 22UH |
| L 006 | 1 | 24-80369A23 | COIL | 15UH |
| L 007 | 1 | 24-80369A23 | COIL | 15UH |
| L 008 | 1 | 24-80369A23 | COIL | 15UH |
| L 009 | 1 | 24-80369A23 | COIL | 15UH |
| L 010 | 1 | 24-80369A23 | COIL | 15UH |
| L 011 | 1 | 24-80369A23 | COIL | 15UH |
| P 001 | 1 | 01-80304A53 | CABLE ASSEMBLY | 24 PIN-18IN-SIDE |
| P 002 | 1 | 30-80304A54 | CABLE ASSEMBLY | 16 PIN-10IN END |
| RT001 | 1 | 06C83600K05 | THERMISTOR | |
| S 013 | 1 | 40-80335A74 | WAFFER,SWITCH | |

Figure 17-4. RF Input Module A11 (RTC-1002B) Parts Location Diagram (Sheet 2 of 2)

| Find No. | Qty. Req. | Part No. | Nomenclature | Part Value |
|---|---|---|---|---|
| 001 | 1 | 84-80335A17 | PWB,RF CONV/WB AMP | |
| 002 | AR | SN62WRMAP3 | SOLDER | |
| 003 | AR | 11-14167A01 | INK | BLACK |
| 004 | AR | SN63WRP3 | SOLDER | |
| 005 | AR | SN63WRMAP3 | SOLDER | |
| 006 | 1 | 26-P00234N001 | SHIELD,CAN | |
| 007 | 1 | 26-P00235N001 | SHIELD,FILTER | |
| 008 | AR | RTV3145 | ADHESIVE,SILICONE | |
| 009 | 1 | 26-P06855R001 | SHIELD | |
| 010 | AR | M23053/5-105-9 | INSULATING SLEEVIN | .187 WHT |
| 011 | AR | 30-84421F13 | CABLE,RF | WHT |
| 012 | AR | | WIRE,BUS | #22 |
| 013 | AR | | WIRE | #22 WHT |
| 014 | AR | | WIRE,BUS | #24 |
| 015 | 1 | 26-P04143T001 | SHIELD | |
| 016 | AR | | INSULATION SLEEVIN | #22 WHT |
| 017 | AR | M23053/5-103-C | INSULATION SLEEVIN | .093 CLR |
| C 201 | 1 | 21-80370A28 | CAPACITOR | 390PF-20-50 |
| C 202 | 1 | 21-80370A24 | CAPACITOR | 2200PF-20-100 |
| C 203 | 1 | 21-80370A28 | CAPACITOR | 390PF-20-50 |
| C 204 | 1 | 21-80370A24 | CAPACITOR | 2200PF-20-100 |
| C 205 | 1 | 21-80370A29 | CAPACITOR | 680PF-20-50 |
| C 206 | 1 | 23D83441B15 | CAPACITOR | 1.0UF-20-35 |
| C 207 | 1 | 23D83441B15 | CAPACITOR | 1.0UF-20-35 |
| C 208 | 1 | 23D83441B15 | CAPACITOR | 1.0UF-20-35 |
| C 209 | 1 | 21-80370A24 | CAPACITOR | 2200PF-20-100 |
| C 210 | 1 | 23D83441B15 | CAPACITOR | 1.0UF-20-35 |
| C 211 | 1 | 23D83441B15 | CAPACITOR | 1.0UF-20-35 |
| C 212 | 1 | 23D83441B15 | CAPACITOR | 1.0UF-20-35 |
| C 213 | 1 | 23D83441B15 | CAPACITOR | 1.0UF-20-35 |
| C 214 | 1 | 21-80370A24 | CAPACITOR | 2200PF-20-100 |
| C 215 | 1 | 21-80370A29 | CAPACITOR | 680PF-20-50 |
| C 216 | 1 | 21-80370A27 | CAPACITOR | 270PF-20-50 |
| C 217 | 1 | 21-80370A24 | CAPACITOR | 2200PF-20-100 |
| C 218 | 1 | 21-80370A29 | CAPACITOR | 680PF-20-50 |
| C 219 | 1 | 21-80370A24 | CAPACITOR | 2200PF-20-100 |
| C 220 | 1 | 21-80370A28 | CAPACITOR | 390PF-20-50 |
| C 221 | 1 | 21-80370A29 | CAPACITOR | 680PF-20-50 |
| C 222 | 1 | 21-80369A81 | CAPACITOR | 1000PF-0+100-500 |
| C 223 | 1 | 23D83441B15 | CAPACITOR | 1.0UF-20-35 |
| C 224 | 1 | 21-80396A52 | CAPACITOR | .01UF-20+80-200 |
| C 225 | 1 | 21-80396A49 | CAPACITOR | .1UF-20-100 |
| C 226 | 1 | 21-80396A49 | CAPACITOR | .1UF-20-100 |
| C 227 | 1 | 21D84494B42 | CAPACITOR | 27PF-5-500 |
| C 228 | 1 | 21-80369A92 | CAPACITOR | 300PF-5-300 |
| C 229 | 1 | 21D84494B40 | CAPACITOR | 21PF-5-500 |
| C 230 | 1 | 21D82187B08 | CAPACITOR | 220PF-10-500 |
| C 231 | 1 | 21D82428B62 | CAPACITOR | .01UF+80-20-200 |
| C 232 | 1 | 20-80396A57 | CAPACITOR | 9 TO 35PF-200 |
| C 233 | 1 | 21D84494B40 | CAPACITOR | 21PF-5-500 |
| C 234 | 1 | 21-80396A52 | CAPACITOR | .01UF-20+80-200 |
| C 235 | 1 | 21D84494B24 | CAPACITOR | 39PF-5-500 |
| C 236 | 1 | 21D84494B06 | CAPACITOR | 120PF-5-500 |

| Find No. | Qty. Req. | Part No. | Nomenclature | Part Value |
|---|---|---|---|---|
| C 237 | 1 | 23-80396A40 | CAPACITOR | 10UF-25V |
| C 238 | 1 | 21-80396A49 | CAPACITOR | .1UF-20-100 |
| C 239 | 1 | 23D83441B15 | CAPACITOR | 1.0UF-20-35 |
| C 240 | 1 | 21-80396A52 | CAPACITOR | .01UF-20+80-200 |
| C 241 | 1 | 21-80396A52 | CAPACITOR | .01UF-20+80-200 |
| C 242 | 1 | 21-80396A49 | CAPACITOR | .1UF-20-100 |
| C 243 | 1 | 21-80396A49 | CAPACITOR | .1UF-20-100 |
| C 244 | 1 | 21-80369A98 | CAPACITOR | 680PF-10-200 |
| C 245 | 1 | 21-80396A49 | CAPACITOR | .1UF-20-100 |
| C 246 | 1 | 23-80396A40 | CAPACITOR | 10UF-25V |
| C 247 | 1 | 23-80396A40 | CAPACITOR | 10UF-25V |
| C 248 | 1 | 21-80370A24 | CAPACITOR | 2200PF-20-100 |
| C 249 | 1 | 23-80396A41 | CAPACITOR | 15UF-25V |
| C 250 | 1 | 23-80396A41 | CAPACITOR | 15UF-25V |
| C 251 | 1 | 23D83441B15 | CAPACITOR | 1.0UF-20-35 |
| C 252 | 1 | 21-80370A15 | CAPACITOR | 220PF-2-100 |
| C 253 | 1 | 23D83441B15 | CAPACITOR | 1.0UF-20-35 |
| C 254 | 1 | 23-80369A63 | CAPACITOR | 10UF-10-20 |
| C 255 | 1 | 23-80396A40 | CAPACITOR | 10UF-25V |
| C 256 | 1 | 23-80369A58 | CAPACITOR | .18UF-10-50 |
| CR201 | 1 | 48-84463K02 | DIODE | |
| CR202 | 1 | 48-84463K02 | DIODE | |
| CR203 | 1 | 48-84463K02 | DIODE | |
| CR204 | 1 | 48-84463K02 | DIODE | |
| CR205 | 1 | 48-84463K02 | DIODE | |
| CR206 | 1 | 48-80345A62 | DIODE | |
| CR207 | 1 | 48-80345A62 | DIODE | |
| CR208 | 1 | 48-80345A62 | DIODE | |
| CR209 | 1 | 48-84463K02 | DIODE | |
| CR210 | 1 | 48-84463K02 | DIODE | |
| CR211 | 1 | 48-84463K02 | DIODE | |
| CR217 | 1 | 48-80396A29 | DIODE | |
| CR221 | 1 | 48-80396A29 | DIODE | |
| CR222 | 1 | 48-84463K02 | DIODE | |
| CR223 | 1 | 48-84463K02 | DIODE | |
| CR224 | 1 | 48-84463K02 | DIODE | |
| CR225 | 1 | 48-84463K02 | DIODE | |
| CR226 | 1 | 48-84463K02 | DIODE | |
| CR227 | 1 | 48-84463K02 | DIODE | |
| CR228 | 1 | 48-84463K02 | DIODE | |
| FL201 | 1 | 48-80346A10 | FILTER | |
| FL202 | 1 | 48-80346A10 | FILTER | |
| J 003 | 1 | 09-80331A73 | CONNECTOR | |
| J 004 | 1 | 09-80331A73 | CONNECTOR | |
| K 201 | 1 | 80-80346A02 | RELAY | |
| K 202 | 1 | 80-80346A02 | RELAY | |
| K 203 | 1 | 80-80346A02 | RELAY | |

Figure 17-8. RF Converter/Wideband Amplifier A11A2 (RTC-4015B) Parts Location Diagram

| Find No. | Qty. Req. | Part No. | Nomenclature | Part Value |
|---|---|---|---|---|
| L 201 | 1 | 24C83961B01 | CHOKE,RF | |
| L 202 | 1 | 24C83961B01 | CHOKE RF | |
| L 203 | 1 | 24C83961B01 | CHOKE RF | |
| L 204 | 1 | 24C83961B01 | CHOKE RF | |
| L 205 | 1 | 24C83961B01 | CHOKE RF | |
| L 206 | 1 | 24C83961B01 | CHOKE RF | |
| L 207 | 1 | 24C83961B01 | CHOKE,RF | |
| L 208 | 1 | 24C83961B01 | CHOKE RF | |
| L 209 | 1 | 24C83961B01 | CHOKE,RF | |
| L 210 | 1 | 24C83961B01 | CHOKE,RF | |
| L 211 | 1 | 24-80369A28 | COIL | 6.8UH |
| L 212 | 1 | 24E83879G10 | CHOKE VARIABLE | |
| L 213 | 1 | 24-80369A44 | COIL | 4700UH |
| L 214 | 1 | 24C83961B01 | CHOKE RF | |
| L 215 | 1 | 24-80369A44 | COIL | 4700UH |
| L 216 | 1 | 24-80369A44 | COIL | 4700UH |
| L 217 | 1 | 24-80369A47 | CHOKE | 5000UH |
| L 218 | 1 | 24-80369A47 | CHOKE | 5000UH |
| L 219 | 1 | 24-80369A21 | COIL | .68UH |
| L 220 | 1 | 24C83961B01 | CHOKE | |
| L 221 | 1 | 24-80369A15 | COIL | 1UH |
| L 222 | 1 | 24-80369A32 | COIL | 2.2UH |
| M 201 | 1 | 51-80346A05 | MIXER | |
| Q 201 | 1 | 48-80368A91 | TRANSISTOR | MPS6520 SCREENED |
| Q 211 | 1 | 48-80368A92 | TRANSISTOR | MPS6519 SCREENED |
| Q 212 | 1 | 48-80368A91 | TRANSISTOR | MPS6520 SCREENED |
| Q 213 | 1 | 48-80345A42 | TRANSISTOR | |
| R 201 | 1 | 6S124A01 | RESISTOR | 10-5-1/4 |
| R 202 | 1 | 6S124A55 | RESISTOR | 1.8K-5-1/4 |
| R 203 | 1 | 6S124A03 | RESISTOR | 12-5-1/4 |
| R 204 | 1 | 6S124A25 | RESISTOR | 100-5-1/4 |
| R 205 | 1 | 6S124A41 | RESISTOR | 470-5-1/4 |
| R 206 | 1 | 6S124A37 | RESISTOR | 330-5-1/4 |
| R 208 | 1 | 6S124A85 | RESISTOR | 33K-5-1/4 |
| R 209 | 1 | 6S124A73 | RESISTOR | 10K-5-1/4 |
| R 210 | 1 | 6S124A49 | RESISTOR | 1K-5-1/4 |
| R 211 | 1 | 6S124B02 | RESISTOR | 150K-5-1/4 |
| R 212 | 1 | 6S124A61 | RESISTOR | 3.3K-5-1/4 |
| R 213 | 1 | 6S185A25 | RESISTOR | 100-5-1/8 |
| R 214 | 1 | 6S124B22 | RESISTOR | 1M-5-1/4 |
| R 215 | 1 | 6S124A72 | RESISTOR | 9.1K-5-1/4 |
| R 216 | 1 | 6S124B06 | RESISTOR | 220K-5-1/4 |
| R 217 | 1 | 6S124B06 | RESISTOR | 220K-5-1/4 |
| R 218 | 1 | 6S124A89 | RESISTOR | 47K-5-1/4 |
| R 219 | 1 | 6S124A97 | RESISTOR | 100K-5-1/4 |
| R 220 | 1 | 6S124A73 | RESISTOR | 10K-5-1/4 |
| R 221 | 1 | 6S124A73 | RESISTOR | 10K-5-1/4 |
| R 222 | 1 | 6S124A25 | RESISTOR | 100-5-1/4 |
| R 223 | 1 | 6S124A09 | RESISTOR | 22-5-1/4 |
| R 224 | 1 | 6S124A49 | RESISTOR | 1K-5-1/4 |
| R 225 | 1 | 6S124A49 | RESISTOR | 1K-5-1/4 |
| R 226 | 1 | 6S124A67 | RESISTOR | 5.6K-5-1/4 |
| R 227 | 1 | 6S124A97 | RESISTOR | 100K-5-1/4 |

| Find No. | Qty. Req. | Part No. | Nomenclature | Part Value |
|---|---|---|---|---|
| R 231 | 1 | 6S124A09 | RESISTOR | 22-5-1/4 |
| R 232 | 1 | 6S124A03 | RESISTOR | 12-5-1/4 |
| R 233 | 1 | 6S124A03 | RESISTOR | 12-5-1/4 |
| R 239 | 1 | 6S124A81 | RESISTOR | 22K-5-1/4 |
| R 241 | 1 | 6S124A71 | RESISTOR | 8.2K-5-1/4 |
| R 243 | 1 | 6S185A45 | RESISTOR | 680-5-1/8 |
| R 245 | 1 | 6S185A49 | RESISTOR | 1K-5-1/8 |
| R 250 | 1 | 6S124B14 | RESISTOR | 470K-5-1/4 |
| R 251 | 1 | 6S124A89888F888 | RESISTOR | 47K-5-1/4 |
| R 252 | 1 | 18D83452F17 | RESISTOR,VARIABLE | 50K |
| R 256 | 1 | 6S124A18 | RESISTOR | 51-5-1/4 |
| R 257 | 1 | 6S124B10 | RESISTOR | 330K-5-1/4 |
| R 258 | 1 | 18-80370A37 | RESISTOR,VARIABLE | 5K |
| R 259 | 1 | 6S124B22 | RESISTOR | 1M-5-1/4 |
| R 260 | 1 | 6S124A61 | RESISTOR | 3.3K-5-1/4 |
| R 261 | 1 | 6S124A25 | RESISTOR | 100-5-1/4 |
| R 262 | 1 | 6S124A65 | RESISTOR | 4.7K-5-1/4 |
| R 265 | 1 | 6S124A25 | RESISTOR | 100-5-1/4 |
| R 266 | 1 | 6S124A67 | RESISTOR | 5.6K-5-1/4 |
| R 268 | 1 | 6S124A89 | RESISTOR | 47K-5-1/4 |
| R 269 | 1 | 6S124B16 | RESISTOR | 560K-5-1/4 |
| R 271 | 1 | 6S124A46 | RESISTOR | 750-5-1/4 |
| R 272 | 1 | 06-10621B78 | RESISTOR | 681-1-1/8 |
| R 273 | 1 | 06-10621C63 | RESISTOR | 5110-1-1/8 |
| R 274 | 1 | 6S124A45 | RESISTOR | 680-5-1/4 |
| R 275 | 1 | 6S124A65 | RESISTOR | 4.7K-5-1/4 |
| R 276 | 1 | 18D83452F09 | RESISTOR,VARIABLE | 1K |
| R 277 | 1 | 6S185A07 | RESISTOR | 18-5-1/8 |
| R 278 | 1 | 6S185A35 | RESISTOR | 270-5-1/8 |
| R 279 | 1 | 6S185A35 | RESISTOR | 270-5-1/8 |
| R 280 | 1 | 6S124A17 | RESISTOR | 47-5-1/4 |
| R 281 | 1 | 6S185A01 | RESISTOR | 10-5-1/8 |
| R 282 | 1 | 6S124A49 | RESISTOR | 1K-5-1/4 |
| R 283 | 1 | 6S185A43 | RESISTOR | 560-5-1/8 |
| U 201 | 1 | 51-80368A06 | INTEGRATED CIRCUIT | SWA100 SCREENED |
| U 202 | 1 | 51-80368A06 | INTEGRATED CIRCUIT | SWA100 SCREENED |
| U 203 | 1 | 51-80368A06 | INTEGRATED CIRCUIT | SWA100 SCREENED |
| U 204 | 1 | 51-80368A07 | INTEGRATED CIRCUIT | SWA101 SCREENED |
| U 205 | 1 | 51-80368A07 | INTEGRATED CIRCUIT | SWA101 SCREENED |
| U 206 | 1 | 51-80345A04 | INTEGRATED CIRCUIT | CA3240E SCREENED |
| U 207 | 1 | 51-80345A02 | INTEGRATED CIRCUIT | CA3160E SCREENED |
| U 208 | 1 | 51-82884L48 | INTEGRATED CIRCUIT | MC14066BCP SCREENE |
| U 209 | 1 | 51-80396A16 | INTEGRATED CIRCUIT | LM324N SCREENED |
| VR201 | 1 | 48-83461E13 | DIODE,ZENER | |
| VR202 | 1 | 48-80345A93 | DIODE,ZENER | 6.8V-5-4 |
| VR203 | 1 | 48-83624E52 | DIODE,ZENER | |
| VR204 | 1 | 48-83624E52 | DIODE,ZENER | |

Figure 17-8. RF Converter/Wideband Amplifier A11A2 (RTC-4015B) Parts Location Diagram

| Find No. | Qty. Req. | Part No. | Nomenclature | Part Value |
|---|---|---|---|---|
| | | RTC-4016B | OFFSET GENERATOR | |
| 001 | 1 | 84-80335A18 | PWB,OFFSET GENERAT | |
| 002 | AR | SN63WRMAP3 | SOLDER | |
| 003 | AR | 11-14187A01 | INK | BLACK |
| 004 | AR | SN63WRP3 | SOLDER | |
| 005 | 1 | 26-P00345N001 | SHIELD | |
| 006 | AR | M23053/5-105-9 | INSULATING SLEEVIN | .187 WHT |
| 007 | AR | 30-84421F13 | CABLE,RF | WHT |
| 008 | AR | | WIRE,SOLID BUS | #24 |
| 009 | AR | | WIRE | #22 WHT |
| 010 | AR | | INSULATION SLEEVIN | #22 WHT |
| C 301 | 1 | 21-80396A49 | CAPACITOR | .1UF-20-100 |
| C 303 | 1 | 21-80395A52 | CAPACITOR | .01UF-20 + 80-200 |
| C 304 | 1 | 21-80396A49 | CAPACITOR | .1UF-20-100 |
| C 305 | 1 | 21-80396A52 | CAPACITOR | .01UF-20 + 80-200 |
| C 306 | 1 | 20-80396A55 | CAPACITOR | 2 TO 8PF-350 |
| C 307 | 1 | 21K840811 | CAPACITOR | 10PF-N470 |
| C 308 | 1 | 21D84494B30 | CAPACITOR | 34PF-5-500 |
| C 309 | 1 | 20-80396A55 | CAPACITOR | 2 TO 8PF-350 |
| C 310 | 1 | 21D84494B37 | CAPACITOR | 11PF-5-500 |
| C 311 | 1 | 21-80395A51 | CAPACITOR | 1000PF-10-100 |
| C 312 | 1 | 21D84494B37 | CAPACITOR | 11PF-5-500 |
| C 313 | 1 | 21-80396A49 | CAPACITOR | .1UF-20-100 |
| C 314 | 1 | 21-80396A52 | CAPACITOR | .01UF-20 + 80-200 |
| C 315 | 1 | 21-80396A49 | CAPACITOR | 1UF-20-100 |
| C 316 | 1 | 21-80396A52 | CAPACITOR | 01UF-20 + 80-200 |
| C 317 | 1 | 21-80396A52 | CAPACITOR | .01UF-20 + 80-200 |
| C 318 | S01 | 21D84494B34 | CAPACITOR | 68PF-5-500 |
| C 318 | 1 | 21D84494B04 | CAPACITOR | 100PF-5-500 NOMINA |
| C 318 | S01 | 21D84494B06 | CAPACITOR | 120PF-5-500 |
| C 318 | S01 | 21D84426B21 | CAPACITOR | 80PF-5-500 |
| C 319 | 1 | 20-80396A55 | CAPACITOR | 2 TO 8PF-350 |
| C 320 | 1 | 21-80396A51 | CAPACITOR | 1000PF-10-100 |
| C 321 | 1 | 21D84494B42 | CAPACITOR | 27PF-5-500 |
| C 322 | 1 | 21-80396A49 | CAPACITOR | .1UF-20-100 |
| C 323 | 1 | 21-80396A49 | CAPACITOR | .1UF-20-100 |
| C 324 | 1 | 21-80396A49 | CAPACITOR | .1UF-20-100 |
| C 325 | 1 | 21D84494B37 | CAPACITOR | 11PF-5-500 |
| C 326 | 1 | 21-80396A52 | CAPACITOR | .01UF-20 + 80-200 |
| C 327 | 1 | 21-80396A52 | CAPACITOR | .01UF-20 + 80-200 |
| C 328 | 1 | 21D82428B09 | CAPACITOR | 4700PF-10-100 |
| C 329 | 1 | 21D84494B42 | CAPACITOR | 27PF-5-500 |
| C 330 | 1 | 21-80396A49 | CAPACITOR | .1UF-20-100 |
| C 331 | 1 | 21-80396A49 | CAPACITOR | .1UF-20-100 |
| C 332 | 1 | 21-80396A49 | CAPACITOR | .1UF-20-100 |
| C 333 | 1 | 21-80396A49 | CAPACITOR | .1UF-20-100 |
| C 334 | 1 | 21-80396A49 | CAPACITOR | .1UF-20-100 |
| C 335 | 1 | 21-80396A49 | CAPACITOR | .1UF-20-100 |
| C 336 | 1 | 21-80396A49 | CAPACITOR | .1UF-20-100 |
| C 337 | 1 | 21-80396A49 | CAPACITOR | .1UF-20-100 |
| C 338 | 1 | 21-80396A49 | CAPACITOR | .1UF-20-100 |
| C 339 | 1 | 21-80396A52 | CAPACITOR | .01UF-20 + 80-200 |
| C 340 | 1 | 21-80395A52 | CAPACITOR | .01UF-20 + 80-200 |
| C 341 | 1 | 21-80396A49 | CAPACITOR | 1UF-20-100 |
| C 342 | 1 | 21-80396A49 | CAPACITOR | 1UF-20-100 |
| C 343 | 1 | 21-80396A52 | CAPACITOR | 01UF-20 + 80-200 |
| C 344 | 1 | 21-80396A49 | CAPACITOR | .1UF-20-100 |
| C 345 | 1 | 21-80396A49 | CAPACITOR | 1UF-20-100 |
| C 346 | 1 | 21-80396A52 | CAPACITOR | .01UF-20 + 80-200 |
| C 347 | 1 | 23-80396A40 | CAPACITOR | 10UF-25V |
| C 348 | 1 | 23-80396A41 | CAPACITOR | 15UF-25V |
| C 349 | 1 | 23-80396A40 | CAPACITOR | 10UF-25V |
| C 350 | 1 | 21-80396A51 | CAPACITOR | 1000PF-10-100 |
| C 351 | 1 | 21-80396A51 | CAPACITOR | 1000PF-10-100 |
| CR301 | 1 | 48-84453K02 | DIODE | |
| CR303 | 1 | 48-84453K02 | DIODE | |
| CR304 | 1 | 48-84463K02 | DIODE | |
| CR305 | 1 | 48-84453K02 | DIODE | |
| CR306 | 1 | 48-84463K02 | DIODE | |
| CR307 | 1 | 48-84463K02 | DIODE | |
| CR308 | 1 | 48-84462K02 | DIODE | |
| CR309 | 1 | 48-84463K02 | DIODE | |
| CR310 | 1 | 48-84463K02 | DIODE | |
| CR311 | 1 | 48-84453K02 | DIODE | |
| D 301 | 1 | 48-80396A96 | DIODE,VARACTOR | MV309 SCREENED |
| D 302 | 1 | 48-80396A31 | TRANSISTOR | SELECTED MVAM115 |
| D 303 | 1 | 48-80396A31 | TRANSISTOR | SELECTED MVAM115 |
| J 906 | 1 | 09-80331A73 | CONNECTOR | |
| L 301 | 1 | 24-80369A22 | COIL | 1UH |
| L 302 | 1 | 24-80369A20 | COIL | .56UH |
| L 303 | 1 | 24-80369A33 | COIL | 47UH |
| L 304 | 1 | 24-80369A33 | COIL | 47UH |
| L 305 | 1 | 24-80369A30 | COIL | 12UH |
| L 306 | 1 | 24-80369A36 | COIL | 39UH |
| L 307 | 1 | 24C83961B01 | CHOKE RF | |
| L 308 | 1 | 24-80369A38 | COIL | 220UH |
| Q 301 | 1 | 48-80345A42 | TRANSISTOR | |
| Q 302 | 1 | 48 80345A42 | TRANSISTOR | |
| Q 304 | 1 | 48-80368A91 | TRANSISTOR | MPS6520 SCREENED |
| Q 305 | 1 | 48-80368A91 | TRANSISTOR | MPS6520 SCREENED |
| Q 306 | 1 | 48-80368A91 | TRANSISTOR | MPS6520 SCREENED |
| Q 307 | 1 | 48-80368A92 | TRANSISTOR | MPS6519 SCREENED |
| Q 308 | 1 | 48-80368A91 | TRANSISTOR | MPS6520 SCREENED |
| Q 309 | 1 | 48-80368A91 | TRANSISTOR | MPS6520 SCREENED |
| Q 310 | 1 | 48-80368A92 | TRANSISTOR | MPS6519 SCREENED |
| Q 311 | 1 | 48-80368A92 | TRANSISTOR | MPS6519 SCREENED |
| Q 312 | 1 | 48P00869070 | TRANSISTOR | |
| Q 313 | 1 | 48-80368A91 | TRANSISTOR | MPS6520 SCREENED |
| Q 314 | 1 | 48-80368A92 | TRANSISTOR | MPS6519 SCREENED |
| Q 315 | 1 | 48-80368A92 | TRANSISTOR | MPS6519 SCREENED |
| Q 316 | 1 | 48-80368A91 | TRANSISTOR | MPS6520 SCREENED |
| R 301 | 1 | 6S124A73 | RESISTOR | 10K-5-1/4 |
| R 302 | 1 | 6S124A89 | RESISTOR | 47K-5-1/4 |
| R 303 | 1 | 6S124A97 | RESISTOR | 100K-5-1/4 |
| R 304 | 1 | 6S124A73 | RESISTOR | 10K-5-1/4 |
| R 305 | 1 | 18D83452F10 | RESISTOR,VARIABLE | 1K |
| R 306 | 1 | 6S124A97 | RESISTOR | 100K-5-1/4 |
| R 307 | 1 | 6S124A73 | RESISTOR | 10K-5-1/4 |
| R 309 | 1 | 6S124A89 | RESISTOR | 47K-5-1/4 |
| R 311 | 1 | 6S124A45 | RESISTOR | 680-5-1/4 |
| R 313 | 1 | 6S124A53 | RESISTOR | 1.5K-5-1/4 |
| R 314 | 1 | 6S124A51 | RESISTOR | 1.2K-5-1/4 |
| R 315 | 1 | 6S124A41 | RESISTOR | 470-5-1/4 |
| R 316 | 1 | 6S124A73 | RESISTOR | 10K-5-1/4 |
| R 317 | 1 | 6S124A49 | RESISTOR | 1K-5-1/4 |
| R 318 | 1 | 6S124A97 | RESISTOR | 100K-5-1/4 |
| R 319 | 1 | 6S124A73 | RESISTOR | 10K-5-1/4 |
| R 321 | 1 | 6S124A89 | RESISTOR | 47K-5-1/4 |
| R 322 | 1 | 6S124A85 | RESISTOR | 4.7K-5-1/4 |
| R 323 | 1 | 6S124A45 | RESISTOR | 680-5-1/4 |
| R 324 | 1 | 6S124A97 | RESISTOR | 100K-5-1/4 |
| R 325 | 1 | 6S124A97 | RESISTOR | 100K-5-1/4 |
| R 326 | 1 | 6S124A81 | RESISTOR | 22K-5-1/4 |
| R 327 | 1 | 6S124A49 | RESISTOR | 1K-5-1/4 |
| R 328 | 1 | 6S124A41 | RESISTOR | 470-5-1/4 |
| R 329 | 1 | 6S124A47 | RESISTOR | 820-5-1/4 |
| R 330 | 1 | 6S124A51 | RESISTOR | 1.2K-5-1/4 |
| R 332 | 1 | 6S124A41 | RESISTOR | 470-5-1/4 |
| R 333 | 1 | 6S124A71 | RESISTOR | 8.2K-5-1/4 |
| R 334 | 1 | 6S124A41 | RESISTOR | 470-5-1/4 |
| R 335 | 1 | 6S124A57 | RESISTOR | 2.2K-5-1/4 |
| R 336 | 1 | 6S124A57 | RESISTOR | 2.2K-5-1/4 |
| R 337 | 1 | 6S124A57 | RESISTOR | 2.2K-5-1/4 |
| R 338 | 1 | 6S124A73 | RESISTOR | 10K-5-1/4 |
| R 339 | 1 | 6S124A49 | RESISTOR | 1K-5-1/4 |
| R 340 | 1 | 6S124A18 | RESISTOR | 51-5-1/4 |
| R 341 | 1 | 6S124A73 | RESISTOR | 10K-5-1/4 |
| R 342 | 1 | 6S124A73 | RESISTOR | 10K-5-1/4 |
| R 344 | 1 | 6S124A57 | RESISTOR | 2200-5-1/4 |
| R 345 | 1 | 6S124A67 | RESISTOR | 5.6K-5-1/4 |
| R 346 | 1 | 6S124A53 | RESISTOR | 1.5K-5-1/4 |
| R 347 | 1 | 6S124A29 | RESISTOR | 150-5-1/4 |
| R 348 | 1 | 6S124A42 | RESISTOR | 510-5-1/4 |
| R 349 | 1 | 6S124A49 | RESISTOR | 1K-5-1/4 |
| R 350 | 1 | 6S124A49 | RESISTOR | 1K-5-1/4 |
| R 351 | 1 | 6S124A49 | RESISTOR | 1K-5-1/4 |
| R 352 | 1 | 6S124A49 | RESISTOR | 1K-5-1/4 |
| R 353 | 1 | 6S124A49 | RESISTOR | 1K-5-1/4 |
| R 354 | 1 | 6S124A61 | RESISTOR | 3.3K-5-1/4 |
| R 355 | 1 | 6S124A49 | RESISTOR | 1K-5-1/4 |
| R 356 | 1 | 6S124A33 | RESISTOR | 220-5-1/4 |
| R 358 | 1 | 6S124A21 | RESISTOR | 68-5-1/4 |
| R 359 | 1 | 6S124A29 | RESISTOR | 150-5-1/4 |
| R 360 | 1 | 6S124A15 | RESISTOR | 39-5-1/4 |
| R 361 | 1 | 6S124A29 | RESISTOR | 150-5-1/4 |
| R 362 | 1 | 6S124A45 | RESISTOR | 680-5-1/4 |
| R 363 | 1 | 6S124A57 | RESISTOR | 2.2K-5-1/4 |
| R 364 | 1 | 6S124A57 | RESISTOR | 2.2K-5-1/4 |
| R 365 | 1 | 6S124A57 | RESISTOR | 2.2K-5-1/4 |
| R 366 | 1 | 6S124A73 | RESISTOR | 10K-5-1/4 |
| R 367 | 1 | 6S124A49 | RESISTOR | 1K-5-1/4 |
| R 368 | 1 | 6S124A57 | RESISTOR | 2.2K-5-1/4 |
| R 369 | 1 | 6S124A73 | RESISTOR | 10K-5-1/4 |
| R 370 | 1 | 6S124A63 | RESISTOR | 3.9K-5-1/4 |
| R 371 | 1 | 6S124A97 | RESISTOR | 100K-5-1/4 |
| U 301 | 1 | 51-83222M05 | INTEGRATED CIRCUIT | MC1496P SCREENED |
| U 302 | 1 | 51-80345A23 | INTEGRATED CIRCUIT | MC1733CP SCREENED |
| U 303 | 1 | 51-80346A04 | MIXER | |
| VR001 | 1 | 48-84302A09 | DIODE,ZENER | 6.2V-5-4 |

Figure 17-10. Offset Generator A11A3 (RTC-4016B) Parts Location Diagram

# SECTION 18
# FRONT PANEL INTERFACE MODULE (A12)

**18-1. GENERAL.** The front panel interface module contains the input buffers for front panel control to the processor. In addition, buffering and ranging circuits for external scope vertical/horizontal, SINAD, DVM, and frequency counter inputs are in this module. A block diagram and schematic diagram of the Front Panel Interface Module is shown in figures 18-1 and 18-2, respectively.

**18-2. Input Coupling and Ranging.** Scope inputs to the Range Attenuator are from the front panel jack (EXT IN) or from the internal modulation sources (INT SCOPE TO RNG SW). An INT/EXT relay selects the input path. The external path may be AC or DC coupled and is also the path for external DVM, Frequency Counter, and SINAD inputs.

18-3. Four decades of attenuation from 1.0 to 0.001 are provided by the Range Attenuator. The input impedance of the attenuator is 1.0 megohm compensated for a bandwidth of 1 MHz. A unity gain buffer amp following the attenuator provides the drive for the DVM, Frequency Counter, and scope Vertical Preamp circuits.

**18-4. DVM Buffer.** For DC measurements the DVM Buffer provides a 2-pole low pass filter with a minimum of 30 dB attentuation at 50 Hz. For AC measurements the bandwidth of the buffer is switched so that the attenuation at 10 kHz is less than 0.5 dB.

**18-5. Frequency Counter Preamp.** The frequency Counter Preamp has sufficient gain for 30 mV rms sensitivity and provides hystersis for noise immunity.

**18-6. Scope Vertical Preamp.** A calibrated gain of 50 or a variable gain from 5 to 50 is provided by the Vertical Preamp. The gain is controlled from the front panel. From vertical smopepositioning the DC bias point of the preamp is controlled by the front panel position control. Deflection sensitivity at the VERT FROM RNG SW output is 0.5 volt per division.

**18-7. Scope Horizontal Preamp.** A fixed gain of 5 in the Horizontal Preamp gives a horizontal input sensitivity of 0.1 volt per division. Horizontal vernier gain is implemented on the front panel, and horizontal positioning on the Scope Amplifier module. Deflection sensitivity at the HORIZ TO SCOPE AMPL is 0.5 volt per division

**18-8. Control and Display Interface.** Front panel control information is input to the processor in 4-bit groups through the AF control bus. Priority encoders convert the multiposition switch positions (scope horizontal, frequency scan, and RF step attenuator) to 4-bit codes. The processor sequentially addresses each input buffer (AF ADRS BUS 0-3) through the Address Decoder. Data in the selected buffer is then transferred to the processor on the AF DATA BUS 0-3 lines while the $\overline{\text{AF BUS EN 2}}$ signal is low. Two additional latches provide the processor control interface for the Range Attenuator, input switching, and DVM Buffer control.

18-9. AF BUS. The AF Bus consists of a 4-bit tri-state bus data AF DATA BUS 0-3 and a 4-bit address bus AF ADD BUS 0-3. Individual input/output bus locations are addressed by AF ADD BUS 0-3. When $\overline{\text{AF BUS EN 2}}$ is low, the function of the AF DATA BUS lines are determined by the address present on the AF ADD BUS lines

18-10. LED CONTROL. Control output to the display, function, and modulation mode LEDs is by the AF BUS addressed 0, 1, and 2, respectively. Latch select outputs $\overline{\text{LS0}}$, $\overline{\text{LS1}}$, and $\overline{\text{LS2}}$ are low to latch data present on the AF DATA BUS when the corresponsing address is enabled on the AF ADD BUS. These latch select outputs and the AF DATA BUS are connected to the LED display board A14A1.

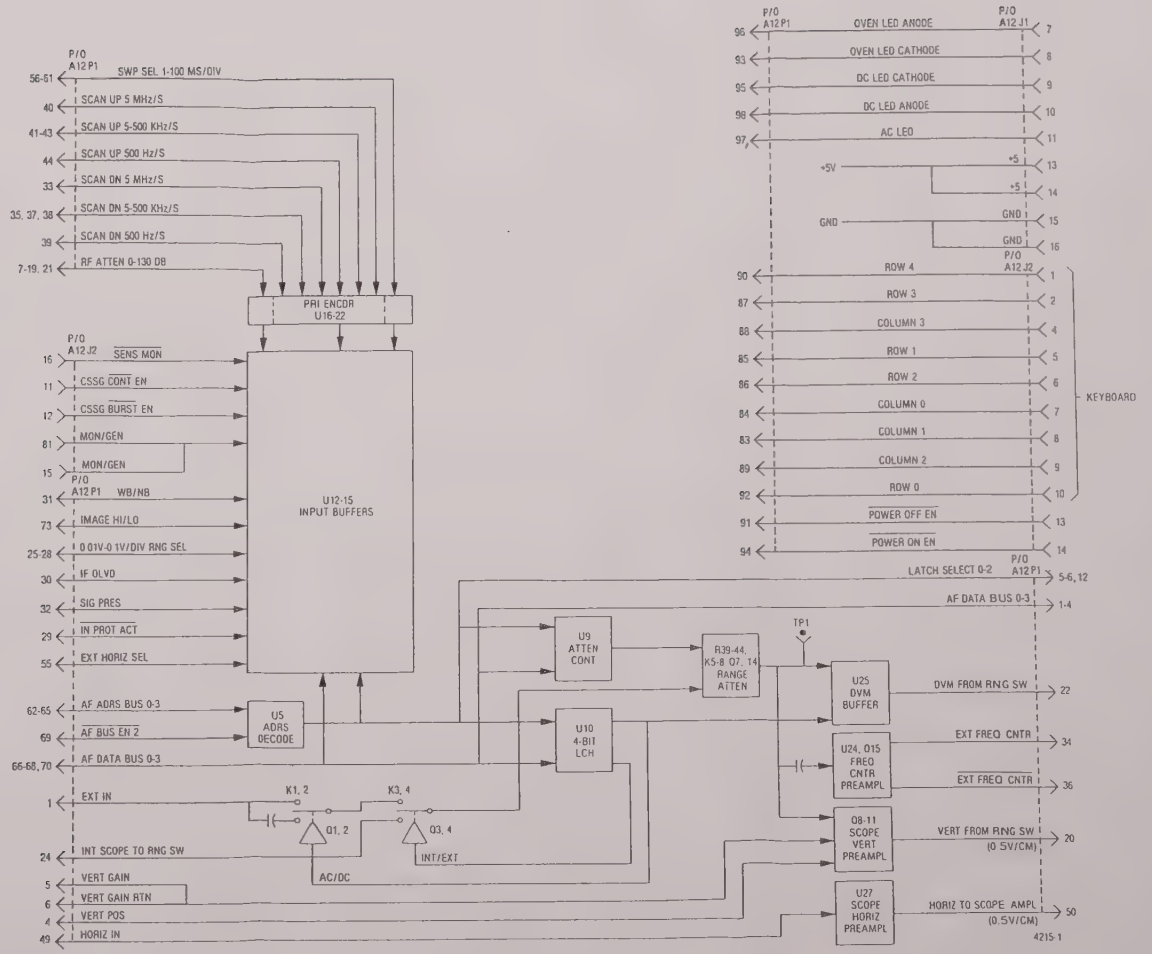



Figure 18-1. Front Panel Interface Module A12 Block Diagram

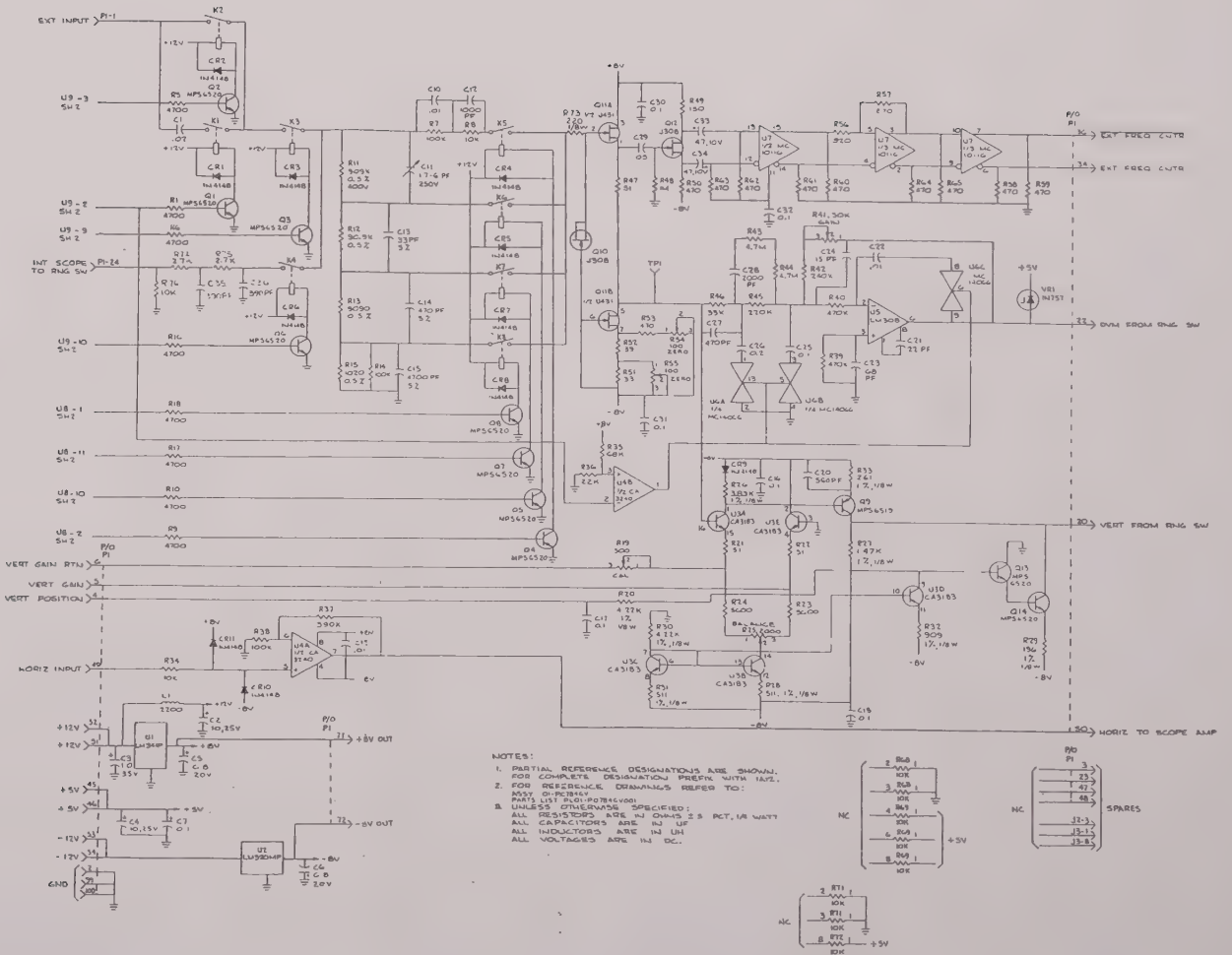

EXT INPUT
INT SCOPE TO RNG SW
VERT GAIN RTN
VERT GAIN
VERT POSITION
HORIZ INPUT
+8V OUT
-8V OUT
GND
EXT FREQ OUTP
EXT FREQ OUTP
SWP FROM RNG SW
VERT FROM RNG SW
HORIZ TO SCOPE AMP
SPARES
NOTES:
1. PARTIAL REFERENCE DESIGNATIONS ARE SHOWN. FOR COMPLETE DESIGNATION PREFIX WITH 1A12.
2. FOR REFERENCE DRAWINGS REFER TO: ASSY 01-P07845V PARTS LIST P101-P07845V001
3. UNLESS OTHERWISE SPECIFIED: ALL RESISTORS ARE IN OHMS ± 5 PCT, 1/8 WATT ALL CAPACITORS ARE IN UF ALL INDUCTORS ARE IN UH ALL VOLTAGES ARE IN DC.

Figure 18-2. Front Panel Interface Module A12 Schematic Diagram (Sheet 1 of 2)

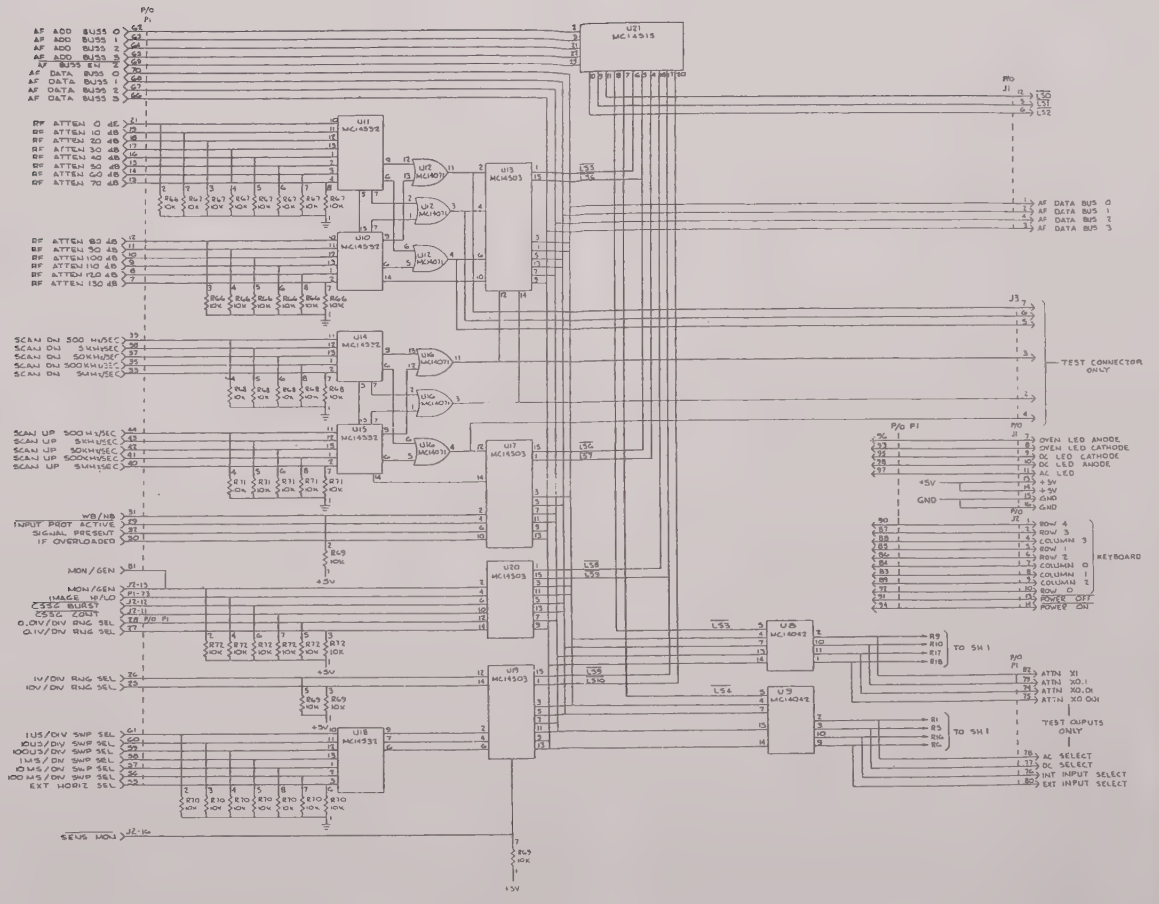



TABLE 1

| REF DES | DEVICE TYPE | GND | VCC CONN | PINS VOLTS | NO CONN |
|---|---|---|---|---|---|
| U1 | 341P | 3 | 1 | +12V | |
| U2 | 320MP | 1 | 3 | -12V | |
| U3 | 3183 | | 5 | -8V | |
| U4 | 3240 | | 8/4 | +8V/8V | |
| U5 | 308 | | 1/4 | +8V/8V | 5 |
| U6 | 14066 | 7,14 | 14/7 | +8V/8V | 10,11 |
| U7 | 10116 | 8 | 1,16 | +5V | |
| U8 | 14042 | 4,8 | 16 | +5V | 3,9,13,15 |
| U9 | 14042 | 4,8 | 16 | +5V | 1,11,13,15 |
| U10 | 14532 | 3,4,6 | 5,16 | +5V | |
| U11 | 14532 | 8 | 16 | +5V | 14,15 |
| U12 | 14031 | 1 | 8,9,14 | +5V | 10 |
| U13 | 14503 | 8 | 16 | +5V | |
| U14 | 14532 | 3,4,8,10 | 16 | +5V | 14,15 |
| U15 | 14532 | 3,4,8,10 | 9,16 | +5V | |
| U16 | 14031 | 1 | 8,9,14 | +5V | 10 |
| U17 | 14503 | 8 | 16 | +5V | |
| U18 | 14532 | 4,8 | 5,16,16 | +5V | 15 |
| U19 | 14503 | 8 | 16 | +5V | |
| U20 | 14503 | 8 | 16 | +5V | |
| U21 | 14515 | 12 | 1,24 | +5V | 13,14,15,16,17 |

Figure 18-2. Front Panel Interface Module A12 Schematic Diagram (Sheet 2 of 2)

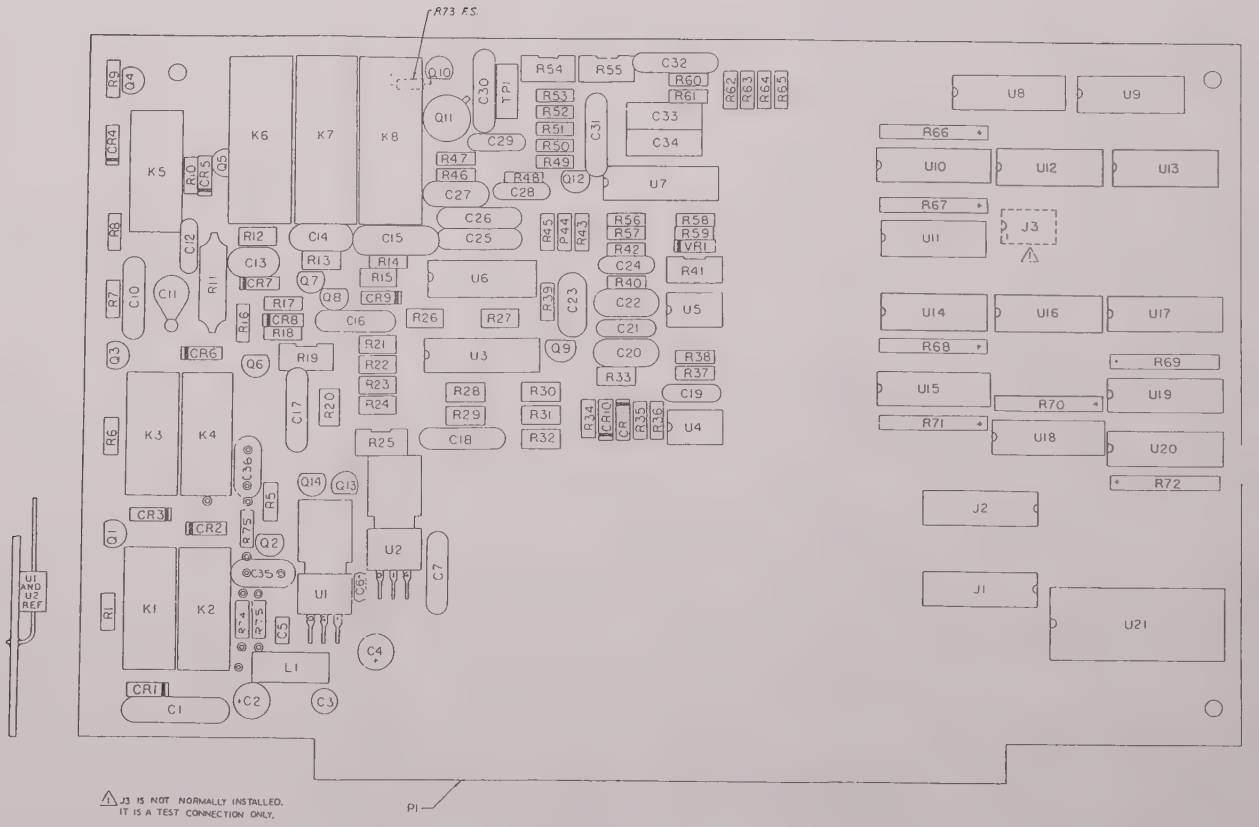



Figure 18-3. Front Panel Interface Module A12 (RTL-4086A) Parts Location Diagram (Sheet 1 of 2)

| Find No. | Qty. Req. | Part No. | Nomenclature | Part Value |
|---|---|---|---|---|
| | | RTL-4086A | F/P INTERFACE | |
| 001 | 1 | 84-P07847V001 | PWB, FRONT PANEL I | |
| 003 | AR | SN63WRMAP3 | SOLDER | |
| 004 | AR | 11-14187A01 | INK | BLACK |
| C 001 | 1 | 21K401029 | CAPACITOR | .02UF-20 – 80-500 |
| C 002 | 1 | 23-80396A40 | CAPACITOR | 10UF-25V |
| C 003 | 1 | 23D83441B15 | CAPACITOR | 1 0UF-20-35 |
| C 004 | 1 | 23 80396A40 | CAPACITOR | 10UF 25V |
| C 005 | 1 | 23D82397D23 | CAPACITOR | 6 8UF-20-20 |
| C 006 | 1 | 23D82397D23 | CAPACITOR | 6 8UF-20-20 |
| C 007 | 1 | 21-80396A49 | CAPACITOR | .1UF-20-100 |
| C 010 | 1 | 21D82428B18 | CAPACITOR | 0.01UF-20-500 |
| C 011 | 1 | 20-80370A32 | CAPACITOR | 2 TO 8PF-250V |
| C 012 | 1 | 21-80396A51 | CAPACITOR | 1000PF-10-100 |
| C 013 | 1 | 21-80369A90 | CAPACITOR | 33PF-5-500 |
| C 014 | 1 | 21D84494B19 | CAPACITOR | 470PF-5-500 |
| C 015 | 1 | 21-80369A96 | CAPACITOR | 4700PF-5-500 |
| C 016 | 1 | 21-80396A49 | CAPACITOR | .1UF-20-100 |
| C 017 | 1 | 21-80396A49 | CAPACITOR | .1UF-20-100 |
| C 018 | 1 | 21-80396A49 | CAPACITOR | .1UF-20-100 |
| C 019 | 1 | 21-80396A52 | CAPACITOR | .01UF-20+80-200 |
| C 020 | 1 | 21-80396A51 | CAPACITOR | 1000PF-10-100 |
| C 021 | 1 | 21-80369A88 | CAPACITOR | 22PF-5-500 |
| C 022 | 1 | 21-80396A52 | CAPACITOR | .01UF-20+80-200 |
| C 023 | 1 | 21D84494B34 | CAPACITOR | 68PF-5-500 |
| C 024 | 1 | 21-859936 | CAPACITOR | 15PF-5-500 |
| C 025 | 1 | 21-80396A49 | CAPACITOR | .1UF-20-100 |
| C 026 | 1 | 21C82372C05 | CAPACITOR | .2UF+80-20-25 |
| C 027 | 1 | 21D82187B07 | CAPACITOR | 470PF-10-500 |
| C 028 | 1 | 21D82428B36 | CAPACITOR | 2000PF-10-200 |
| C 029 | 1 | 21C82372C10 | CAPACITOR | .05UF-20-25 |
| C 030 | 1 | 21-80396A49 | CAPACITOR | .1UF-20-100 |
| C 031 | 1 | 21-80396A49 | CAPACITOR | .1UF-20-100 |
| C 032 | 1 | 21-80396A49 | CAPACITOR | .1UF-20-100 |
| C 033 | 1 | 23D84762H18 | CAPACITOR | 47UF-20-10 |
| C 034 | 1 | 23D84762H18 | CAPACITOR | 47UF-20 10 |
| C 035 | 1 | 21D82187B28 | CAPACITOR | 390PF-10-500 |
| C 036 | 1 | 21D82187B28 | CAPACITOR | 390PF 10 500 |
| CR001 | 1 | 48-84463K02 | DIODE | |
| CR002 | 1 | 48-84463K02 | DIODE | |
| CR003 | 1 | 48-84463K02 | DIODE | |
| CR004 | 1 | 48-84463K02 | DIODE | |
| CR005 | 1 | 48-84463K02 | DIODE | |
| CR006 | 1 | 48-84463K02 | DIODE | |
| CR007 | 1 | 48-84463K02 | DIODE | |
| CR008 | 1 | 48-84463K02 | DIODE | |
| CR009 | 1 | 48-84463K02 | DIODE | |
| CR010 | 1 | 48-84463K02 | DIODE | |
| CR011 | 1 | 48-84463K02 | DIODE | |
| J 001 | 1 | 09-80331A97 | SOCKET,SOLDER DIP | |
| J 002 | 1 | 09-80331A97 | SOCKET,SOLDER DIP | |
| K 001 | 1 | 80-80346A01 | RELAY,REED | 1A-500V |
| K 002 | 1 | 80-80346A01 | RELAY,REED | 1A-500V |
| K 003 | 1 | 80-80346A01 | RELAY,REED | 1A-500V |
| K 004 | 1 | 80-80346A01 | RELAY,REED | 1A-500V |
| K 005 | 1 | 80-80346A01 | RELAY,REED | 1A-500V |
| K 006 | 1 | 80084157B01 | REED RELAY | 1A |
| K 007 | 1 | 80084157B01 | REED RELAY | 1A |
| K 008 | 1 | 80084157B01 | REED RELAY | 1A |

| Find No. | Qty. Req. | Part No. | Nomenclature | Part Value |
|---|---|---|---|---|
| L 001 | 1 | 24-80369A43 | COIL | 2200UH |
| Q 001 | 1 | 48-80368A91 | TRANSISTOR | MPS6520 SCREENED |
| Q 002 | 1 | 48-80368A91 | TRANSISTOR | MPS6520 SCREENED |
| Q 003 | 1 | 48-80368A91 | TRANSISTOR | MPS6520 SCREENED |
| Q 004 | 1 | 48-80368A91 | TRANSISTOR | MPS6520 SCREENED |
| Q 005 | 1 | 48-80368A91 | TRANSISTOR | MPS6520 SCREENED |
| Q 006 | 1 | 48-80368A91 | TRANSISTOR | MPS6520 SCREENED |
| Q 007 | 1 | 48-80368A91 | TRANSISTOR | MPS6520 SCREENED |
| Q 008 | 1 | 48-80368A91 | TRANSISTOR | MPS6520 SCREENED |
| Q 009 | 1 | 48-80368A92 | TRANSISTOR | MPS6519 SCREENED |
| Q 010 | 1 | 48-80345A41 | TRANSISTOR | |
| Q 011 | 1 | 48-80368A90 | TRANSISTOR | |
| Q 012 | 1 | 48-80345A41 | TRANSISTOR | |
| Q 013 | 1 | 48-80368A91 | TRANSISTOR | MPS6520 SCREENED |
| Q 014 | 1 | 48-80368A91 | TRANSISTOR | MPS6520 SCREENED |
| R 001 | 1 | 6S124A65 | RESISTOR | 4.7K-5-1/4 |
| R 005 | 1 | 6S124A65 | RESISTOR | 4,7K-5-1/4 |
| R 006 | 1 | 6S124A65 | RESISTOR | 4,7K-5-1/4 |
| R 007 | 1 | 6S124A97 | RESISTOR | 100K-5-1/4 |
| R 008 | 1 | 6S124A73 | RESISTOR | 10K-5-1/4 |
| R 009 | 1 | 6S124A65 | RESISTOR | 4,7K-5-1/4 |
| R 010 | 1 | 6S124A65 | RESISTOR | 4.7K-5-1/4 |
| R 011 | 1 | 06-80396A73 | RESISTOR | 909K-.1-1W-900 |
| R 012 | 1 | 06-80396A71 | RESISTOR | 90.9K-.1-1/4 |
| R 013 | 1 | 06-80396A70 | RESISTOR | 9090-.1-1/4 |
| R 015 | 1 | 06-80396A60 | RESISTOR | 1010-.1-1/4 |
| R 016 | 1 | 6S124A65 | RESISTOR | 4,7K-5-1/4 |
| R 017 | 1 | 6S124A65 | RESISTOR | 4,7K-5-1/4 |
| R 018 | 1 | 6S124A65 | RESISTOR | 4.7-5-1/4 |
| R 019 | 1 | 18D83452F07 | RESISTOR,VARIABLE | 500 |
| R 020 | 1 | 06-10621C55 | RESISTOR | 4220-1-1/8 |
| R 021 | 1 | 6S124A18 | RESISTOR | 51-5-1/4 |
| R 022 | 1 | 6S124A18 | RESISTOR | 51-5-1/4 |
| R 023 | 1 | 6S124A67 | RESISTOR | 5.6K-5-1/4 |
| R 024 | 1 | 6S124A67 | RESISTOR | 5.6K-5-1/4 |
| R 025 | 1 | 18D83452F01 | RESISTOR VARIABLE | 2K |
| R 026 | 1 | 06-10621C51 | RESISTOR | 3830-1 1/8 |
| R 027 | 1 | 06-10621C11 | RESISTOR | 1470 1-1/8 |
| R 028 | 1 | 06-10621B66 | RESISTOR | 511 1 1/8 |
| R 029 | 1 | 06-10621B26 | RESISTOR | 196-1 1/8 |
| R 030 | 1 | 06-10621C55 | RESISTOR | 4220-1-1/8 |
| R 031 | 1 | 06-10621B66 | RESISTOR | 511 1 1/8 |
| R 032 | 1 | 06-10621B90 | RESISTOR | 909-1-1/8 |
| R 033 | 1 | 06-10621B38 | RESISTOR | 261-1-1/8 |
| R 034 | 1 | 6S124A73 | RESISTOR | 10K-5-1/4 |
| R 035 | 1 | 6S124A93 | RESISTOR | 68K-5-1/4 |
| R 036 | 1 | 6S124A81 | RESISTOR | 22K-5-1/4 |
| R 037 | 1 | 6S124B12 | RESISTOR | 390K-5-1/4 |
| R 038 | 1 | 6S124A97 | RESISTOR | 100K-5-1/4 |
| R 039 | 1 | 6S124B14 | RESISTOR | 470K-5-1/4 |
| R 040 | 1 | 6S124B14 | RESISTOR | 470K-5-1/4 |
| R 041 | 1 | 18D83452F17 | RESISTOR,VARIABLE | 50K |
| R 042 | 1 | 06-10621E26 | RESISTOR | 243K-1-1/8 |
| R 043 | 1 | 6S124B38 | RESISTOR | 4.7M-5-1/4 |
| R 044 | 1 | 6S124B38 | RESISTOR | 4.7M-5-1/4 |
| R 045 | 1 | 06-10621E22 | RESISTOR | 221K-1-1/8 |
| R 046 | 1 | 06-10621A50 | RESISTOR | 32.4K-1-1/8 |
| R 047 | 1 | 06-10621D60 | RESISTOR | 51.1-1-1/8 |
| R 048 | 1 | 6S124B22 | RESISTOR | 1M-5-1/4 |

| Find No. | Qty. Req. | Part No. | Nomenclature | Part Value |
|---|---|---|---|---|
| | | | | |
| R 049 | 1 | 6S124A29 | RESISTOR | 150-5-1/4 |
| R 050 | 1 | 6S124A41 | RESISTOR | 470-5-1/4 |
| R 051 | 1 | 06-10621A51 | RESISTOR | 33.2-1-1/8 |
| R 052 | 1 | 06-10621A58 | RESISTOR | 39 2-1-1/8 |
| R 053 | 1 | 6S124A41 | RESISTOR | 470-5-1/4 |
| R 054 | 1 | 18D83452F03 | RESISTOR,VARIABLE | 100 |
| R 055 | 1 | 18D83452F03 | RESISTOR VARIABLE | 100 |
| R 056 | 1 | 6S124A47 | RESISTOR | 820 5-1/4 |
| R 057 | 1 | 6S124A41 | RESISTOR | 470-5-1/4 |
| R 058 | 1 | 6S124A41 | RESISTOR | 470-5-1/4 |
| R 059 | 1 | 6S124A41 | RESISTOR | 470-5-1/4 |
| R 060 | 1 | 6S124A41 | RESISTOR | 470-5-1/4 |
| R 061 | 1 | 6S124A41 | RESISTOR | 470-5-1/4 |
| R 062 | 1 | 6S124A41 | RESISTOR | 470-5-1/4 |
| R 063 | 1 | 6S124A41 | RESISTOR | 470-5-1/4 |
| R 064 | 1 | 6S124A41 | RESISTOR | 470-5-1/4 |
| R 065 | 1 | 6S124A41 | RESISTOR | 470-5-1/4 |
| R 066 | 1 | 51-80368A80 | RESISTOR | 10K |
| R 067 | 1 | 51-80368A80 | RESISTOR | 10K |
| R 068 | 1 | 51-80368A80 | RESISTOR | 10K |
| R 069 | 1 | 51-80368A80 | RESISTOR | 10K |
| R 070 | 1 | 51-80368A80 | RESISTOR | 10K |
| R 071 | 1 | 51-80368A80 | RESISTOR | 10K |
| R 072 | 1 | 51-80368A80 | RESISTOR | 10K |
| R 073 | 1 | 6S185A33 | RESISTOR | 220-5-1/8 |
| R 074 | 1 | 6S124A59 | RESISTOR | 2700-5-1/4 |
| R 075 | 1 | 6S124A59 | RESISTOR | 2700-5-1/4 |
| R 076 | 1 | 6S124A73 | RESISTOR | 10K-5-1/4 |
| TP001 | 1 | 09-80331A88 | JACK,TIP | WHT |
| U 001 | 1 | 51-80345A08 | INTEGRATED CIRCUIT | LM341P-8.0 SCREENE |
| U 002 | 1 | 51-80345A07 | INTEGRATED CIRCUIT | LM320MP-8.0 SCREEN |
| U 003 | 1 | 51-80345A03 | INTEGRATED CIRCUIT | CA3183E SCREENED |
| U 004 | 1 | 51-80345A04 | INTEGRATED CIRCUIT | CA3240E SCREENED |
| U 005 | 1 | 51-80368A82 | INTEGRATED CIRCUIT | LM308AN SCREENED |
| U 006 | 1 | 51-82884L48 | INTEGRATED CIRCUIT | MC14066BCP SCREENE |
| U 007 | 1 | 51-80323A60 | INTEGRATED CIRCUIT | MC10116P SCREENED |
| U 008 | 1 | 51-80368A58 | INTEGRATED CIRCUIT | MC14042B SCREENED |
| U 009 | 1 | 51-80368A58 | INTEGRATED CIRCUIT | MC14042B SCREENED |
| U 010 | 1 | 51-80368A51 | INTEGRATED CIRCUIT | MC14532BCP SCREENE |
| U 011 | 1 | 51-80368A51 | INTEGRATED CIRCUIT | MC14532BCP SCREENE |
| U 012 | 1 | 51-80368A43 | INTEGRATED CIRCUIT | MC14071BCP SCREENE |
| U 013 | 1 | 51-80368A47 | INTEGRATED CIRCUIT | MC14503BCP SCREENE |
| U 014 | 1 | 51-80368A51 | INTEGRATED CIRCUIT | MC14532BCP SCREENE |
| U 015 | 1 | 51-80368A51 | INTEGRATED CIRCUIT | MC14532BCP SCREENE |
| U 016 | 1 | 51-80368A43 | INTEGRATED CIRCUIT | MC14071BCP SCREENE |
| U 017 | 1 | 51-80368A47 | INTEGRATED CIRCUIT | MC14503BCP SCREENE |
| U 018 | 1 | 51-80368A51 | INTEGRATED CIRCUIT | MC14532BCP SCREENE |
| U 019 | 1 | 51-80368A47 | INTEGRATED CIRCUIT | MC14503BCP SCREENE |
| U 020 | 1 | 51-80368A47 | INTEGRATED CIRCUIT | MC14503BCP SCREENE |
| U 021 | 1 | 51-80345A22 | INTEGRATED CIRCUIT | MC14515BCP SCREENE |
| VR001 | 1 | 48-82256C38 | DIODE,ZENER | |

VR001

Figure 18-3. Front Panel Interface Module A12 (RTL-4086A) Parts Location Diagram (Sheet 2 of 2)

# SECTION 19
# 10 MHz FREQUENCY STANDARD MODULE (A13)

**19-1. General.** The frequency Standard Module provides a stable 10 MHz source and the interface for an external 10 MHz input. A block diagram of the Frequency Standard Module is shown in figure 19-1 with its schematic shown in figure 19-2.

19-2. 10 MHz Oscillator and Control. The internal 10 MHz source is either a temperature compensated crystal oscillator (TCXO) or an optional ovenized crystal oscillator (OVXO). A voltage regulator on the module supplies the voltage to the oscillator and monitors the supply current. For the ovenized option, at power on, the oven draws high current. As the oven warms up the current decreases, reaching some low value when the operating temperature has been reached. A current detector illuminates the oven ready indicator when the current has decreased to the stabilized value. The indicator is continuously illuminated with the TCXO.

19-3. Internal/External Switchover. With no signal at the external 10 MHz input jack, the internal oscillator is gated to the SYNTH 10 MHz and the external 10 MHz OUT signal paths. When an external 10 MHz input is applied the switchover circuitry detects its presence, removes the power from the internal oscillator, and gates the external input to the SYNTH 10 MHz and external 10 MHz OUT signal paths. The oven ready indicator is extinguished when the system is operating from an external standard.

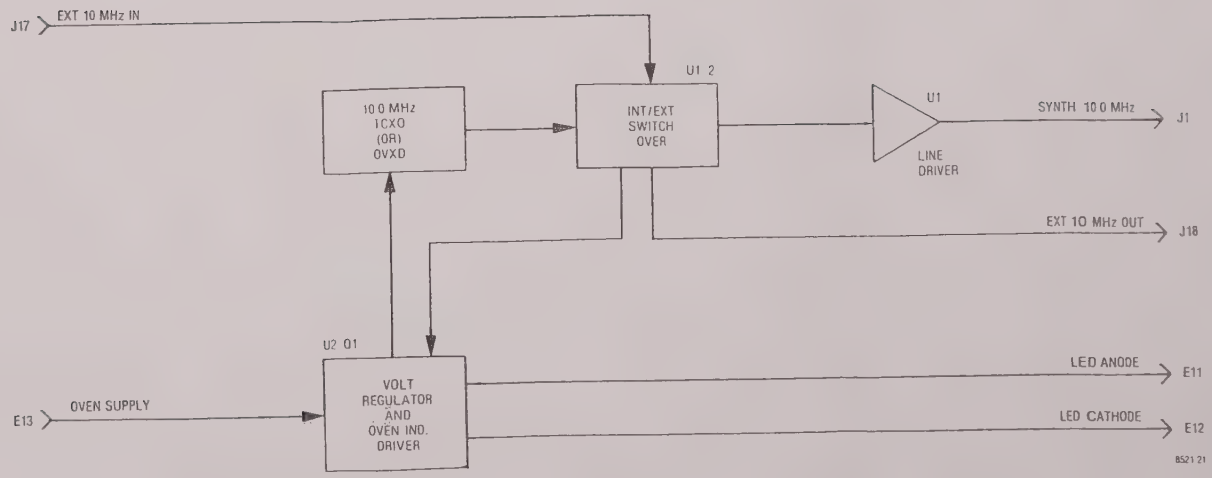



Figure 19-1. Frequency Standard Module A13 Block Diagram

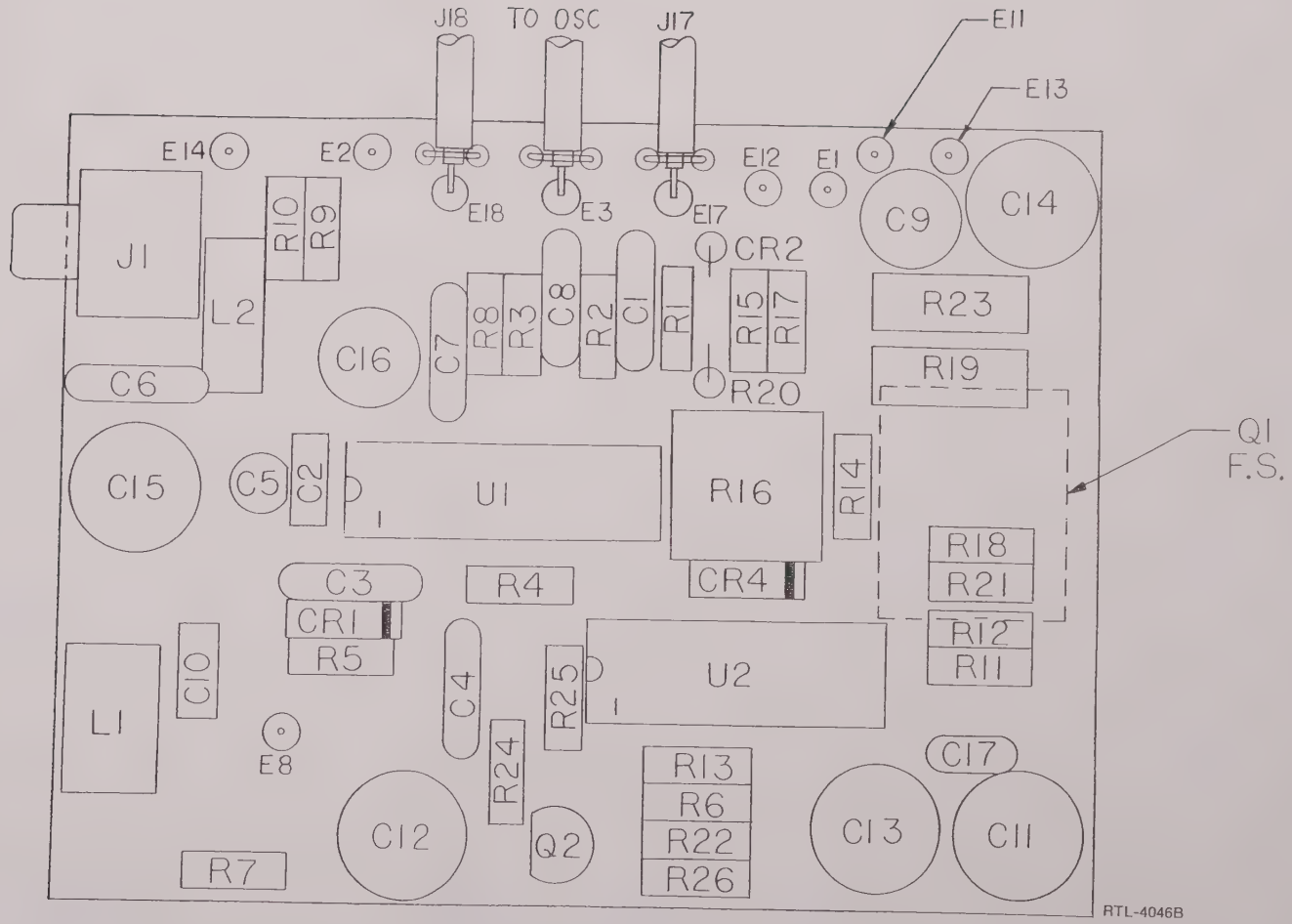
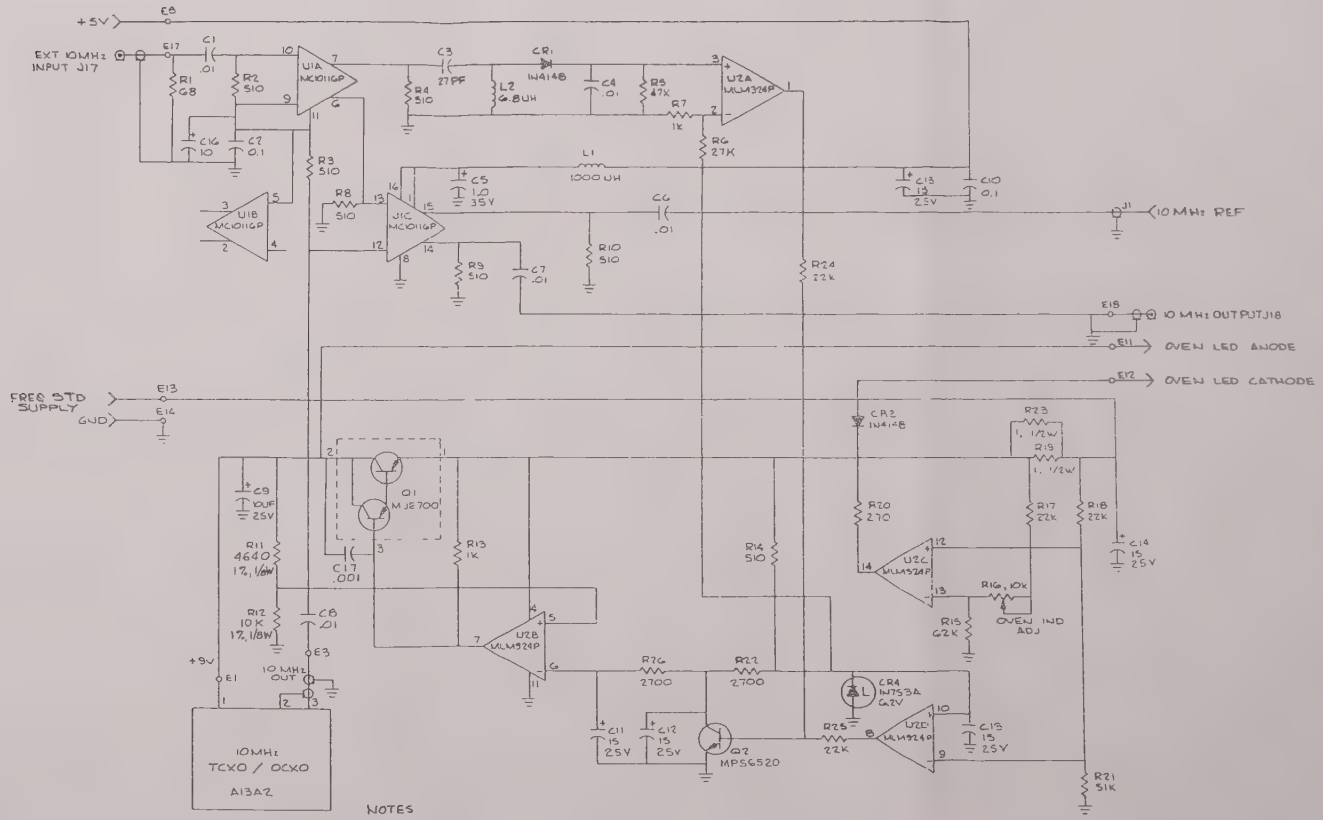



Figure 19-4. Frequency Standard Module A13 PWB Parts Location Diagram (Sheet 1 of 2)




NOTES

1. TOP ASSY A13 01-P07898V
   PWB ASSY A13A1 01-P00375W002
   A13A2 OCXO 58-P00355N
   A13A2 TCXO 58-P00354N

2. CAPACITORS ARE IN UF UNLESS NOTED
3. RESISTORS ARE ¼ W UNLESS NOTED

Figure 19-2. Frequency Standard Module A13 Schematic Diagram

| Find No. | Qty. Req. | Part No. | Nomenclature | Part Value |
|---|---|---|---|---|
| A13 | | RTL-1011A | FREQUENCY STANDARD | |
| 003 | 1 | 07-P07885V001 | BRACKET,OSC | |
| 004 | 7 | 03-139581 | SCREW,PH | 4-40X.312 |
| 005 | 7 | 04-114583 | WASHER,LOCK | .112 |
| 006 | 4 | 04-7607 | WASHER,FLAT | .125 |
| 009 | AR | 30-84421F13 | CABLE,RF | WHT |
| 010 | 2 | 1107-4-A-7 | SPACER | |
| 011 | 1 | 64-P06839R001 | PLATE, CONNECTOR M | |
| 012 | 1 | 29-15122A17 | TERMINAL,LUG | |
| 013 | AR | | WIRE | #24 WHT |
| 014 | AR | SN63WRP3 | SOLDER | |
| 015 | AR | 11-14167A01 | INK | BLACK |
| 016 | 1 | 14-15140A08 | INSULATOR,MICA | |
| 017 | AR | | WIRE | #22 WHT |
| 018 | 3 | NAS620C4L | WASHER | NO.4 |
| 019 | AR | M23053/5-204-C | INSULATION SLEEVIN | .125 CLR |
| 020 | AR | | WIRE,SOLID BUS | #24 |
| A 001 | 1 | RTL-4045B | 10MHZ STD INTERFAC | |
| A 002 | 1 | 01-80307A98 | REF OSC,10MHZ,TCXO | |
| J 017 | 1 | 09-80331A69 | CONNECTOR,RF | |
| J 018 | 1 | 09-80331A69 | CONNECTOR,RF | |

NOTES:

1. FOR REFERENCE DOCUMENTS REFER TO: 63-P08059V SCHEMATIC DIAG.
2. PARTIAL REFERENCE DESIGNATIONS ARE SHOWN. FOR COMPLETE DESIGNATION PREFIX WITH A13.
3. SOLDER ALL ELECTRICAL CONNECTIONS IN ACCORDANCE WITH REQUIREMENT 5 OF MIL-STD-454 USING FIND NO. 14.
4. INSTALL FIND NO. 16 BETWEEN TRANSISTOR ON A1 AND BRACKET FIND NO. 3.
5. "E" TERMINATION LOCATIONS ARE SHOWN FOR REFERENCE ONLY AND ARE NOT TO BE MARKED ON THE ASSEMBLY.
6. SOLDER COAX CABLE SHIELDS TO P.W.B. AND CONNECTORS USING FIND NO. 14 AND 20.
7. MARK SERIAL NUMBER, A13, AND PART NUMBER 01-P07898V□□ IN ACCORDANCE WITH MIL-STD-130 IN .12 MIN. HIGH GOTHIC CHARACTERS USING FIND NO. 15.

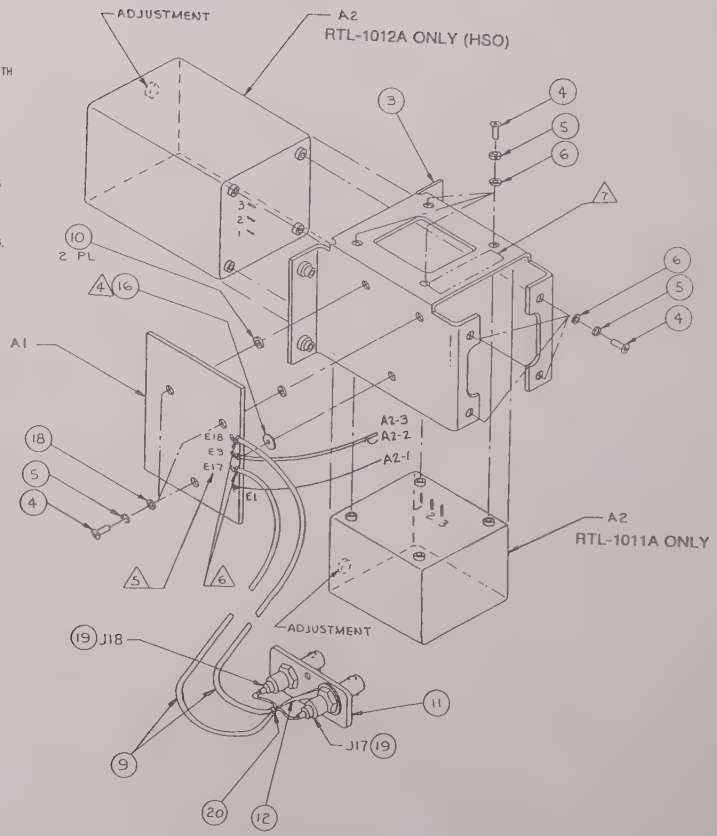



Figure 19-3. Frequency Standard Module A13 (RTL-1011A) Parts Location Diagram

| Find No. | Qty. Req. | Part No. | Nomenclature | Part Value |
|---|---|---|---|---|
| | | RTL-4046B | 10MHZ INTERFACE | |
| 001 | 1 | 84-80335A26 | PWB,10MHZ INTERFAC | |
| 002 | AR | SN63WRP3 | SOLDER | |
| 003 | AR | 11-14167A01 | INK | BLACK |
| 004 | AR | SN96WRMAP3 | SOLDER | |
| C 001 | 1 | 21-80396A52 | CAPACITOR | .01UF-20+80-200 |
| C 002 | 1 | 21-80369A82 | CAPACITOR | .1UF-20-100 |
| C 003 | 1 | 21D84494B42 | CAPACITOR | 27PF-5-500 |
| C 004 | 1 | 21-80396A52 | CAPACITOR | .01UF-20+80-200 |
| C 005 | 1 | 23D83441B15 | CAPACITOR | 1.0UF-20-35 |
| C 006 | 1 | 21-80396A52 | CAPACITOR | .01UF-20+80-200 |
| C 007 | 1 | 21-80396A52 | CAPACITOR | .01UF-20+80-200 |
| C 008 | 1 | 21-80396A52 | CAPACITOR | .01UF-20+80-200 |
| C 009 | 1 | 23-80396A40 | CAPACITOR | 10UF-25V |
| C 010 | 1 | 21-80369A82 | CAPACITOR | .1UF-20-100 |
| C 011 | 1 | 23-80396A41 | CAPACITOR | 1SUF-25V |
| C 012 | 1 | 23-80396A41 | CAPACITOR | 1SUF-25V |
| C 013 | 1 | 23-80396A41 | CAPACITOR | 1SUF-25V |
| C 014 | 1 | 23-80396A41 | CAPACITOR | 1SUF-25V |
| C 015 | 1 | 23-80396A41 | CAPACITOR | 1SUF-25V |
| C 016 | 1 | 23-80396A40 | CAPACITOR | 10UF-25V |
| C 017 | 1 | 21-80396A52 | CAPACITOR | .01UF-20+80-200 |
| CR001 | 1 | 48-84463K02 | DIODE | |
| CR002 | 1 | 48-84463K02 | DIODE | |
| CR004 | 1 | 48-84302A09 | DIODE,ZENER | 6.2V-5-.4 |
| J 001 | 1 | 901 | CONNECTOR,PHONE JA | |
| L 001 | 1 | 24-80369A42 | COIL | 1000UH |
| L 002 | 1 | 24-80369A16 | CHOKE | |
| Q 001 | 1 | 48-80321A06 | TRANSISTOR | |
| Q 002 | 1 | 48-80368A91 | TRANSISTOR | MPS6520 SCREENED |

| Find No. | Qty. Req. | Part No. | Nomenclature | Part Value |
|---|---|---|---|---|
| R 025 | 1 | 6S124A81 | RESISTOR | 22K-5-1/4 |
| R 026 | 1 | 6S124A59 | RESISTOR | 2.7K-5-1/4 |
| U 001 | 1 | 51-80323A50 | INTEGRATED CIRCUIT | MC10116P SCREENED |
| U 002 | 1 | 51-80396A16 | INTEGRATED CIRCUIT | LM324N SCREENED |
| R 001 | 1 | 6S124A21 | RESISTOR | 68-5-1/4 |
| R 002 | 1 | 6S124A42 | RESISTOR | 510-5-1/4 |
| R 003 | 1 | 6S124A42 | RESISTOR | 510-5-1/4 |
| R 004 | 1 | 6S124A42 | RESISTOR | 510-5-1/4 |
| R 005 | 1 | 6S124A89 | RESISTOR | 47K-5-1/4 |
| R 006 | 1 | 6S124A83 | RESISTOR | 27K-5-1/4 |
| R 007 | 1 | 6S124A49 | RESISTOR | 1K-5-1/4 |
| R 008 | 1 | 6S124A42 | RESISTOR | 510-5-1/4 |
| R 009 | 1 | 6S124A42 | RESISTOR | 510-5-1/4 |
| R 010 | 1 | 6S124A42 | RESISTOR | 510-5-1/4 |
| R 011 | 1 | 06-10621C59 | RESISTOR | 464G-1-1/8 |
| R 012 | 1 | 06-10621C91 | RESISTOR | 10K-1-1/8 |
| R 013 | 1 | 6S124A49 | RESISTOR | 1K-5-1/4 |
| R 014 | 1 | 6S124A42 | RESISTOR | 510-5-1/4 |
| R 015 | 1 | 6S124A92 | RESISTOR | 62K-5-1/4 |
| R 016 | 1 | 18D83452F14 | RESISTOR,VARIABLE | 10K |
| R 017 | 1 | 6S124A81 | RESISTOR | 22K-5-1/4 |
| R 018 | 1 | 6S124A81 | RESISTOR | 22K-5-1/4 |
| R 019 | 1 | 6S125B70 | RESISTOR | 1-5-1/2 |
| R 020 | 1 | 6S124A35 | RESISTOR | 270-5-1/4 |
| R 021 | 1 | 6S124A90 | RESISTOR | 51K-5-1/4 |
| R 022 | 1 | 6S124A59 | RESISTOR | 2.7K-5-1/4 |
| R 023 | 1 | 6S125B70 | RESISTOR | 1-5-1/2 |
| R 024 | 1 | 6S124A81 | RESISTOR | 22K-5-1/4 |

Figure 19-4. Frequency Standard Module A13 PWB Parts Location Diagram

# SECTION 20
# FRONT PANEL (A14)

**20-1. GENERAL.** The front panel assembly consists of a display board module and the analyzer operating switches and controls. A schematic diagram of the front panel assembly is shown in figure 20-1.

**20-2. DISPLAY BOARD.** The display board holds and decodes LED data. A display of 27 LEDs is driven by 24 drivers and three inputs from external sources. The keyboard is a 5-row by 4-column matrix of momentary contact switches. Jumper connections on the board are used to route signals between connectors. The display board consists of three latch/decoders, 24 LED drivers, and a 27 LED display. A display board block diagram is shown in figure 20-2.

20-3. The three latch/decoders hold and decode input data from the AF DATA BUS 0-3. Signals $\overline{LS0}$-$\overline{LS2}$ are latch selects that transfer data from the AF DATA BUS 0-3 to the corresponding latch. Only one LED at a time can be turned on by any of the three latch selects. Each driver is an open-collector device which sinks current through its respective LED.

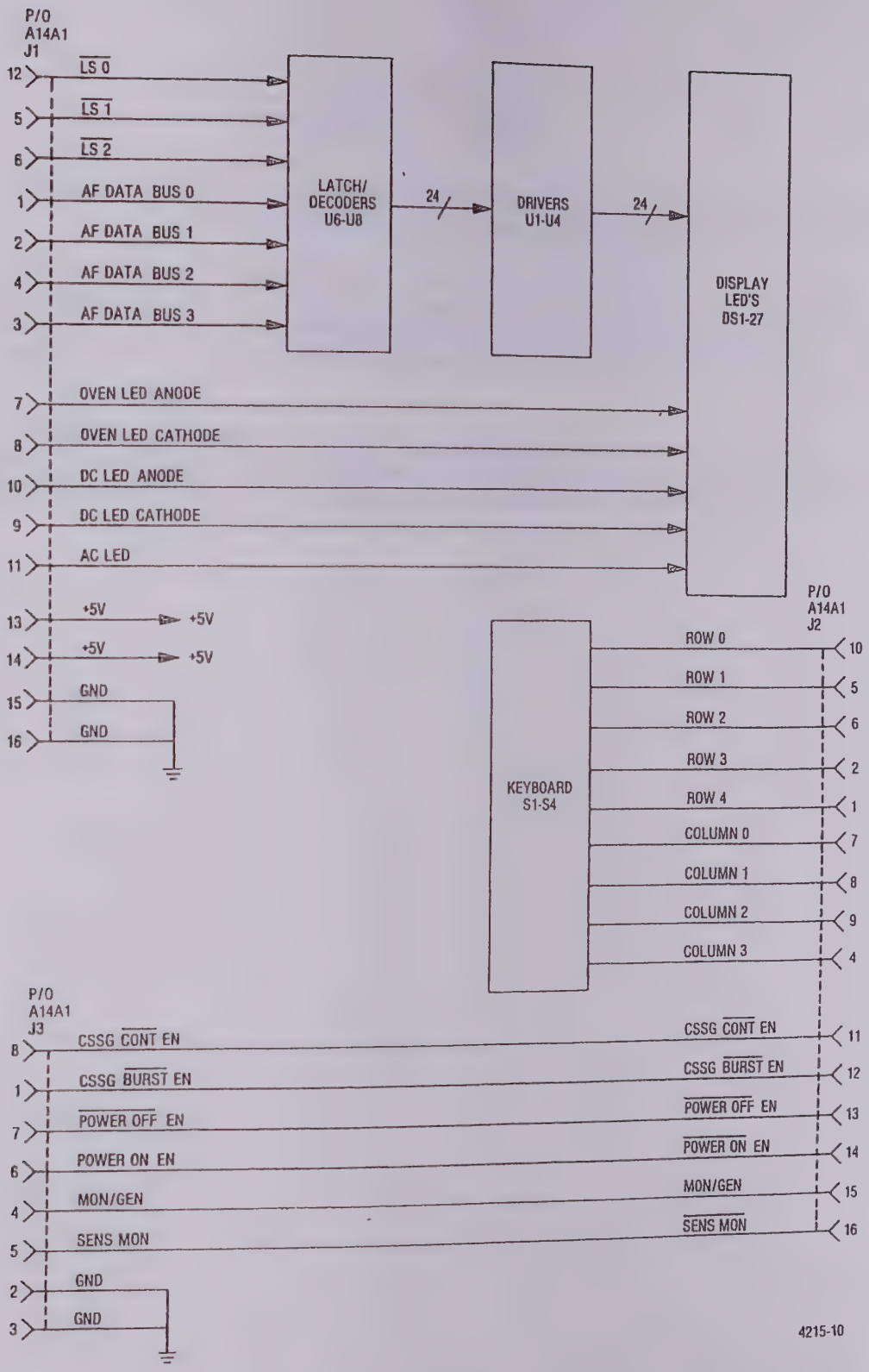
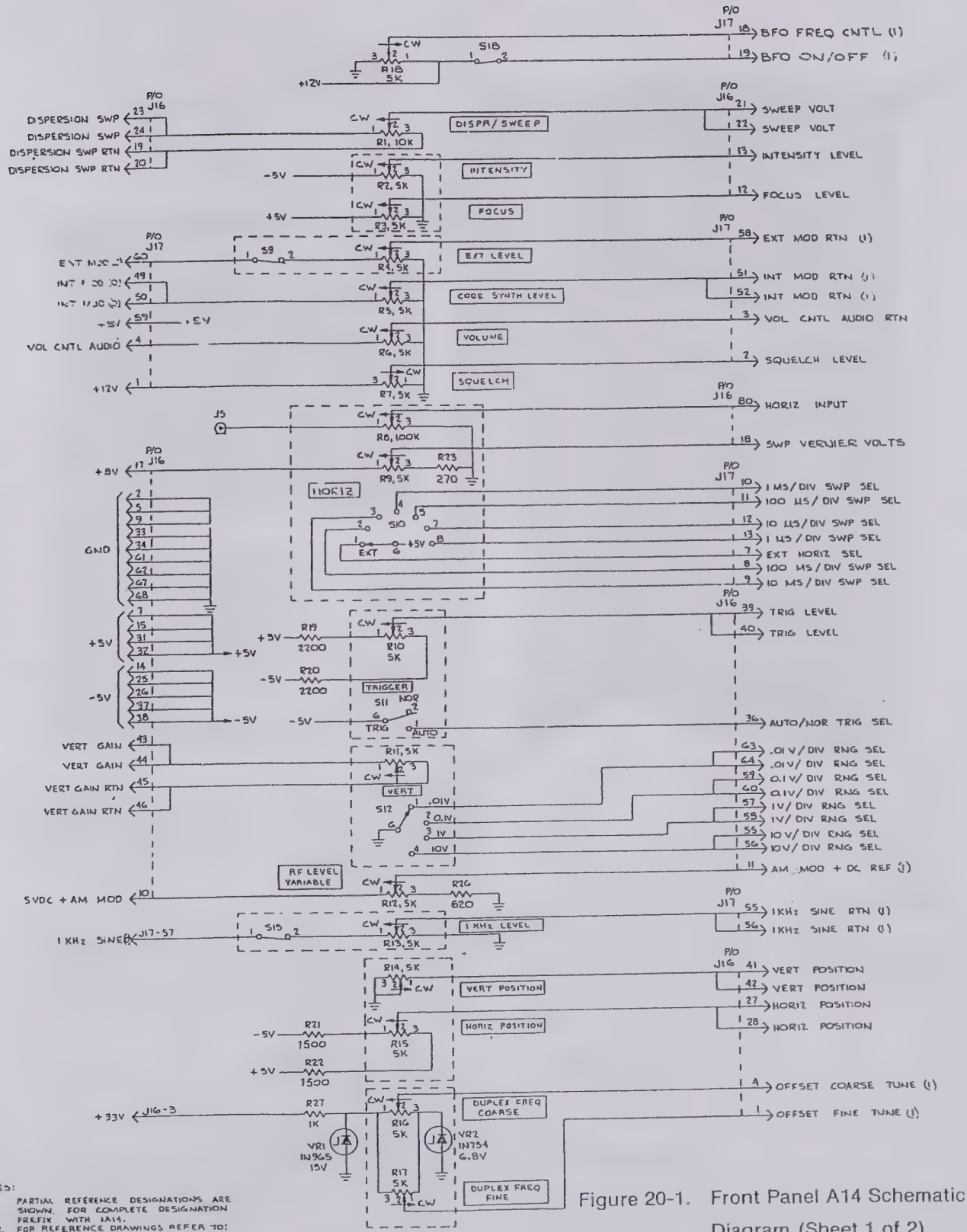



Figure 20-3. Display Board A14A1 Block Diagram




NOTES:

1. PARTIAL REFERENCE DESIGNATIONS ARE SHOWN. FOR COMPLETE DESIGNATION PREFIX WITH 1A14.
2. FOR REFERENCE DRAWINGS REFER TO:
   01-P07860V FRONT PANEL ASSEMBLY
   01-P07843V DISPLAY BD ASSEMBLY
   63-P07699V DISPLAY BD SCHEMATIC
   01-P07868V SWITCH PWB ASSEMBLY
3. UNLESS OTHERWISE SPECIFIED:
   ALL RESISTORS ARE IN OHMS, ± 5PCT, 1/4 WATT.
   ALL VOLTAGES ARE DC.

4 APPLIES TO IEEE OPTION ONLY FOR REFERENCE DRAWING SEE: 01-P07860V FRONT PANEL ASSEMBLY

Figure 20-1. Front Panel A14 Schematic Diagram (Sheet 1 of 2)

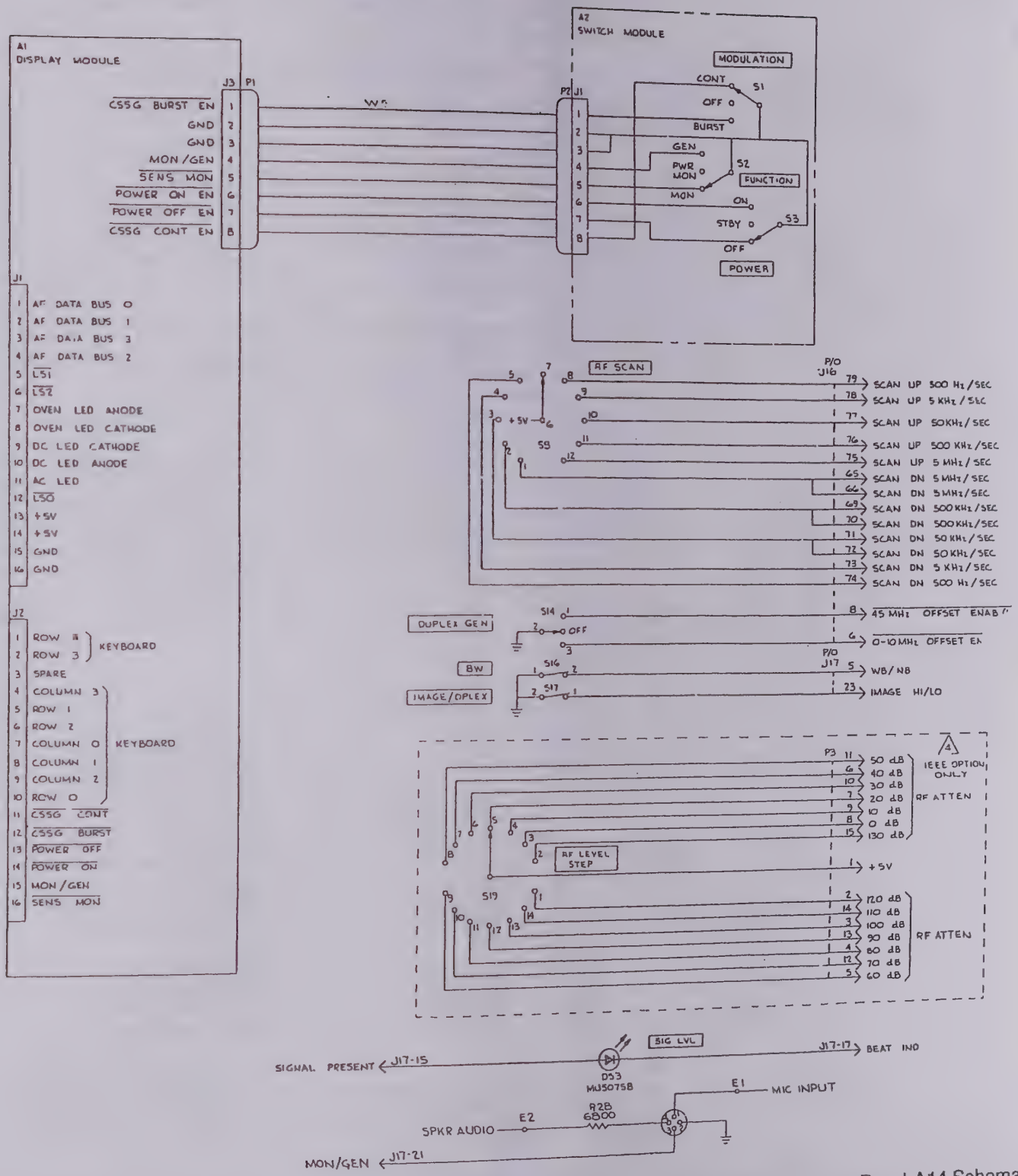



Figure 20-1. Front Panel A14 Schematic Diagram (Sheet 2 of

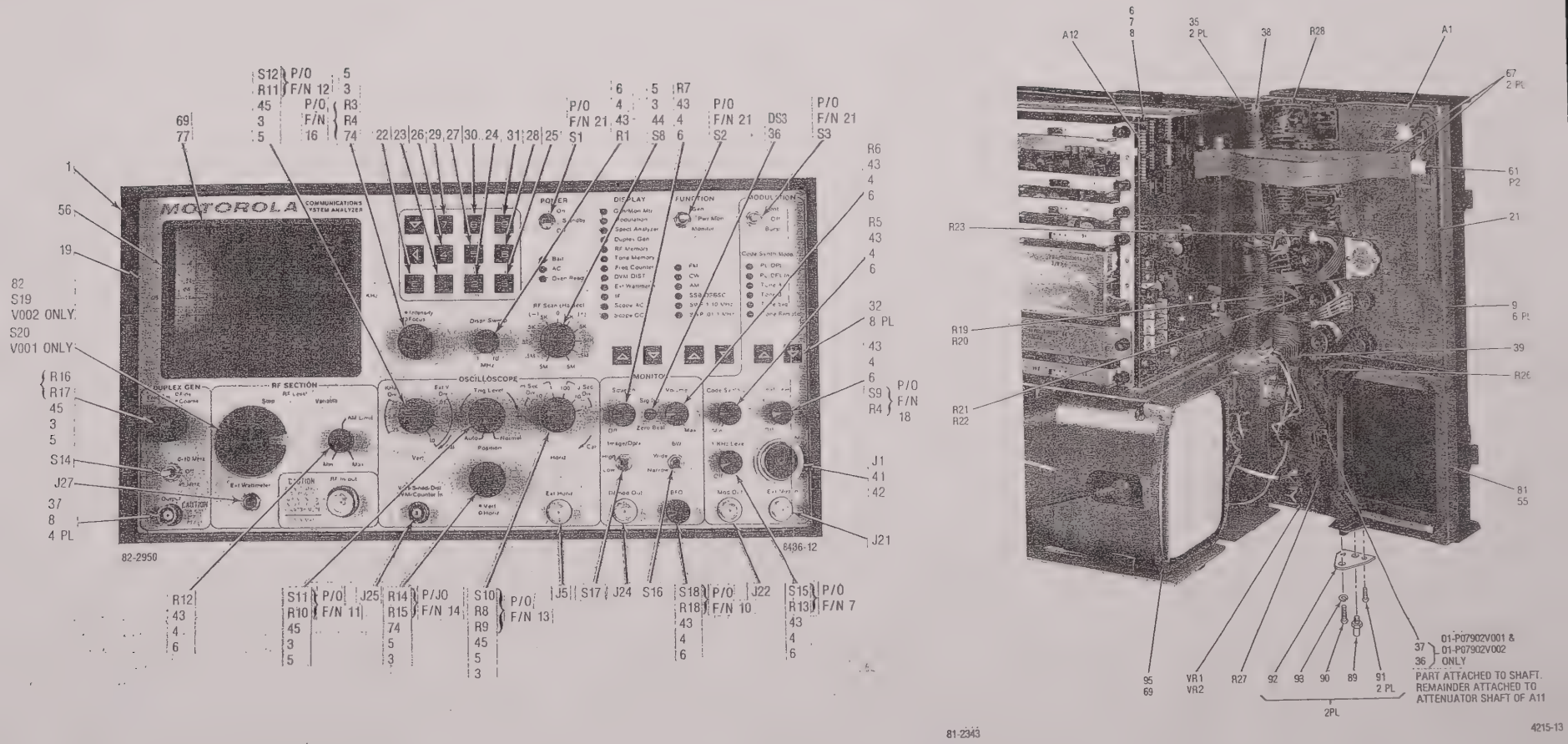



Figure 20-2 Front Panel A14 (01-80305A64) Parts Location Diagram (Sheet 1 of 3)

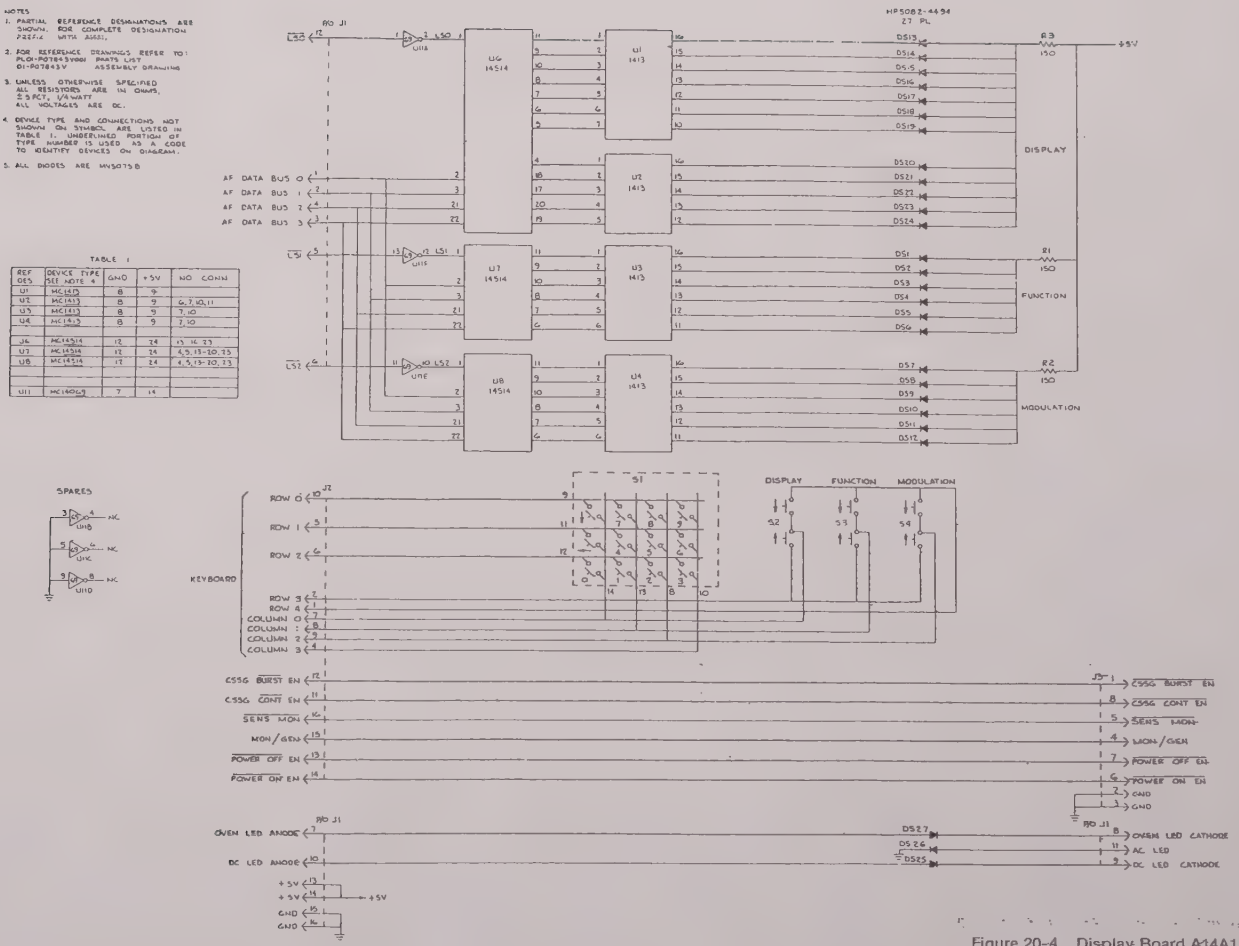



Figure 20-4 Display Board A14A1 Schematic Diagram

| Find No. | Qty. Req. | Part No. | Nomenclature | Part Value |
|---|---|---|---|---|
| A14 | | 1-80305A64 | FRONT PANEL | |
| 001 | 1 | 64-P07888V001 | PANEL,FRONT | REQUIRES PAINT |
| 003 | 7 | 1195M | NUT,COMPONENT | 3/8-32 |
| 004 | 8 | 1245M | NUT,COMPONENT | 1/4-32 |
| 005 | 7 | 1220-02 | WASHER,LOCK | 3/8 |
| 006 | 8 | 1214-05 | WASHER,LOCK | 1/4 |
| 007 | 6 | MS35335-29 | WASHER,EXT LOCK | .112 |
| 008 | 8 | 3-56X1/4SSFL,PH82 | SCREW,FL HD 82 DEG | 3-56X1/4 |
| 009 | 6 | MS35206-216 | SCREW,MACH,PH | .1120-40X.437 |
| 010 | 1 | 18-80346A17 | RESISTOR,VARIABLE/ | BFO |
| 011 | 1 | 40-80335A78 | SWITCH,RESISTOR VA | SCOPE TRIG |
| 012 | 1 | 40-80335A77 | SWITCH,RESISTOR VA | SCOPE VERT |
| 013 | 1 | 40-80335A76 | SWITCH/DUAL RESIST | |
| 014 | 1 | 18-80346A13 | RESISTOR,VAR,DUAL, | |
| 015 | 1 | 18-80346A19 | RESISTOR,VAR,DUAL, | |
| 016 | 1 | 18-80346A13 | RESISTOR,VAR,DUAL, | |
| 017 | 1 | 18-80346A18 | RESISTOR,VARIABLE/ | 1KV LEVEL |
| 018 | 1 | 18-80346A18 | RESISTOR,VARIABLE/ | 1KV LEVEL |
| 019 | 1 | 64-80396A78 | FRONT PANEL OVERLA | |
| 020 | 1 | 43-15069A02 | BUSHING | |
| 021 | 1 | 84-P07842V001 | PWB SWITCH INTERCO | |
| 022 | 1 | 38-80331A49 | PUSHBUTTON,SWITCH- | |
| 023 | 1 | 38-80331A50 | PUSHBUTTON,SWITCH- | |
| 024 | 1 | 38-80331A51 | PUSHBUTTON,SWITCH- | |
| 025 | 1 | 38-80331A52 | PUSHBUTTON,SWITCH- | |
| 026 | 1 | 38-80331A53 | PUSHBUTTON,SWITCH- | |
| 027 | 1 | 38-80331A54 | PUSHBUTTON,SWITCH- | |
| 028 | 1 | 38-80331A55 | PUSHBUTTON,SWITCH- | |
| 029 | 1 | 38-80331A56 | PUSHBUTTON,SWITCH- | |
| 030 | 1 | 38-80331A57 | PUSHBUTTON,SWITCH- | |
| 031 | 1 | 38-80331A58 | PUSHBUTTON,SWITCH- | |
| 032 | 8 | 38-80331A48 | PUSHBUTTOM,SWITCH, | |
| 035 | 2 | 09-80331A67 | CONNECTOR | 80 PIN W/O EARS |
| 036 | 1 | 004-9011 | HOLDER,LED | |
| 037 | 1 | 30-P00213N001 | CABLE ASSEMBLY,OFF | FRONT PANEL/A11 |
| 038 | 1 | 84-80331A39 | PWB,FLEX,LEFTSIDE, | |
| 039 | 1 | 84-80348A95 | PWB,FLEX RIGHTSIDE | |
| 041 | 1 | 2-482070 | NUT,COMP | |
| 042 | 1 | 4-7699 | WASHER,COMP | |
| 043 | 8 | 36-80396A84 | KNOB | 1/8 SHAFT |
| 044 | 1 | 36-80396A85 | KNOB | 1/4 SHAFT |
| 045 | 3 | 36-80396A82 | KNOB,DUAL | 1/8-1/4 SHAFT |
| 047 | AR | SN63WRMAP3 | SOLDER | |
| 048 | AR | 11-14167A01 | INK | BLACK |
| 049 | AR | | WIRE | #22 WHT |
| 050 | AR | M17/113-RG316 | CABLE,RF | WHT |
| 052 | AR | M23053/5-105-9 | INSULATING SLEEVIN | .187 WHT |
| 053 | AR | M23053/5-103-9 | INSULATION SLEEVIN | .093 WHT |
| 054 | AR | | ENCAPSULANT SILICO | |
| 055 | 1 | 75-80335A50 | ISOLATOR,CRT FRONT | |
| 056 | 1 | 13-80331A99 | BEZEL | |
| 057 | 1 | 36-80396A81 | KNOB,DUAL | 1/8-1/4 SHAFT |
| 058 | AR | | WIRE | #24 WHT |
| 059 | AR | SN63WRP3 | SOLDER | |
| 061 | 1 | 01-80305A60 | CABLE ASSEMBLY,RIB | |
| 074 | 2 | 36-80396A83 | KNOB,DUAL | .158-.238 SHAFT |
| 076 | AR | RTV3145 | ADHESIVE | |
| 080 | AR | | COMPOUND,THD LKG,P | TYPE II, GR M,#222 |
| 081 | 1 | 09-80331A95 | SOCKET,SOLDER DIP | |
| 082 | 2 | 01-80305A56 | CABLE ASSEMBLY,RIB | |
| 083 | 8 | 03-P07961V009 | SCREW,PH ASSEMBLED | 6-32X.312 |
| 084 | 2 | 46-80348A99 | STUD HANDLE | |
| 085 | 2 | MS16996-9 | SCREW | .190-32X.375 |
| 086 | 4 | 03-80311A31 | SCREW | .138-32X.375 |
| 087 | 2 | 54-P0414ST001 | PLATE,DOUBLE | |
| 088 | 2 | MS35338-138 | WASHER | .190 |
| 089 | 2 | 55-80335A89 | HINGE | |
| 090 | 2 | 55-80331A85 | STRIKE,CATCH | |
| 091 | AR | | COMPOUND,THD LKG,B | TYPE II,GR N,#242 |
| A 001 | 1 | 01-80305A63 | DISPLAY BOARD ASSY | |
| D 003 | 1 | 48084404E03 | LED | |
| J 001 | 1 | 9-830418 | CONNECTOR,MIC | |
| J 005 | 1 | 09-80331A69 | CONNECTOR,RF | |
| J 021 | 1 | 09-80331A69 | CONNECTOR,RF | |
| J 022 | 1 | 09-80331A69 | CONNECTOR,RF | |
| J 024 | 1 | 09-80331A69 | CONNECTOR,RF | |
| J 025 | 1 | 86425 | CONNECTOR,RF | |
| J 027 | 1 | 09-80331A70 | CONNECTOR,PHONE JA | |
| R 001 | 1 | 18-80346A15 | RESISTOR,VAR,DISPR | 10K-10-1/4 |
| R 002 | 1 | 06- | RESISTOR | PART OF F/N 15 |
| R 003 | 1 | 06- | RESISTOR | PART OF F/N 16 |
| R 004 | 1 | 06- | RESISTOR | PART OF F/N 18 |
| R 005 | 1 | 18-80346A16 | RESISTOR,VAR,INT,M | 5K |
| R 006 | 1 | 18-80346A14 | RESISTOR,VAR,AUDIO | 5K |
| R 007 | 1 | 18-80346A14 | RESISTOR,VAR,AUDIO | 5K |
| R 008 | 1 | 06- | RESISTOR | PART OF F/N 13 |
| R 009 | 1 | 06- | RESISTOR | PART OF F/N 13 |
| R 010 | 1 | 06- | RESISTOR | PART OF F/N 11 |
| R 011 | 1 | 06- | RESISTOR | PART OF F/N 12 |
| R 012 | 1 | 18-80346A14 | RESISTOR,VAR,AUDIO | 5K |
| R 013 | 1 | 06- | RESISTOR | PART OF F/N 17 |
| R 014 | 1 | 06- | RESISTOR | PART OF F/N 14 |
| R 015 | 1 | 06- | RESISTOR | PART OF F/N 14 |
| R 016 | 1 | 06- | RESISTOR | PART OF F/N 15 |
| R 017 | 1 | 06- | RESISTOR | PART OF F/N 15 |
| R 018 | 1 | 06- | RESISTOR | PART OF F/N 10 |
| R 019 | 1 | 6S124A57 | RESISTOR | 2.2K-5-1/4 |
| R 020 | 1 | 6S124A57 | RESISTOR | 2.2K-5-1/4 |
| R 021 | 1 | 6S124A57 | RESISTOR | 2.2K-5-1/4 |
| R 022 | 1 | 6S124A57 | RESISTOR | 2.2K-5-1/4 |
| R 023 | 1 | 6S124A35 | RESISTOR | 270-5-1/4 |
| R 026 | 1 | 6S124A44 | RESISTOR | 620-5-1/4 |
| R 027 | 1 | 6S124A49 | RESISTOR | 1K-5-1/4 |
| R 028 | 1 | 6S125A69 | RESISTOR | 6.8K-5-1/2 |
| S 001 | 1 | 40-80335A82 | SWITCH,TOGGLE | |
| S 002 | 1 | 40 80335A81 | SWITCH TOGGLE | SP3T,OFFSET |
| S 003 | 1 | 40-80335A81 | SWITCH,TOGGLE | SP3T,OFFSET |
| S 008 | 1 | 40-80335A75 | SWITCH,ROTARY | 1 POL,1 1 POS,RF SC |
| S 009 | 1 | 40- | SWITCH | PART OF F/N 16 |
| S 010 | 1 | 40- | SWITCH | PART OF F/N 13 |
| S 011 | 1 | 40- | SWITCH | PART OF F/N 11 |
| S 012 | 1 | 40- | SWITCH | PART OF F/N 12 |
| S 014 | 1 | 40-80335A81 | SWITCH,TOGGLE | SP3T,OFFSET |
| S 015 | 1 | 40- | SWITCH | PART OF F/N 17 |
| S 016 | 1 | 40-80335A80 | SWITCH,TOGGLE | SP5TWB/NB |
| S 017 | 1 | 40-80335A80 | SWITCH,TOGGLE | SP5TWB/NB |
| S 018 | 1 | 40- | SWITCH | PART OF F/N 10 |
| VR001 | 1 | 48-80345A96 | DIODE | 15V-20-.4 |
| VR002 | 1 | 48-80345A93 | DIODE,ZENER | 6.8V-5-.4 |

Figure 20-2. Front Panel A14 (01-80305A64) Parts Location Diagram (Sheet 2 of 3)

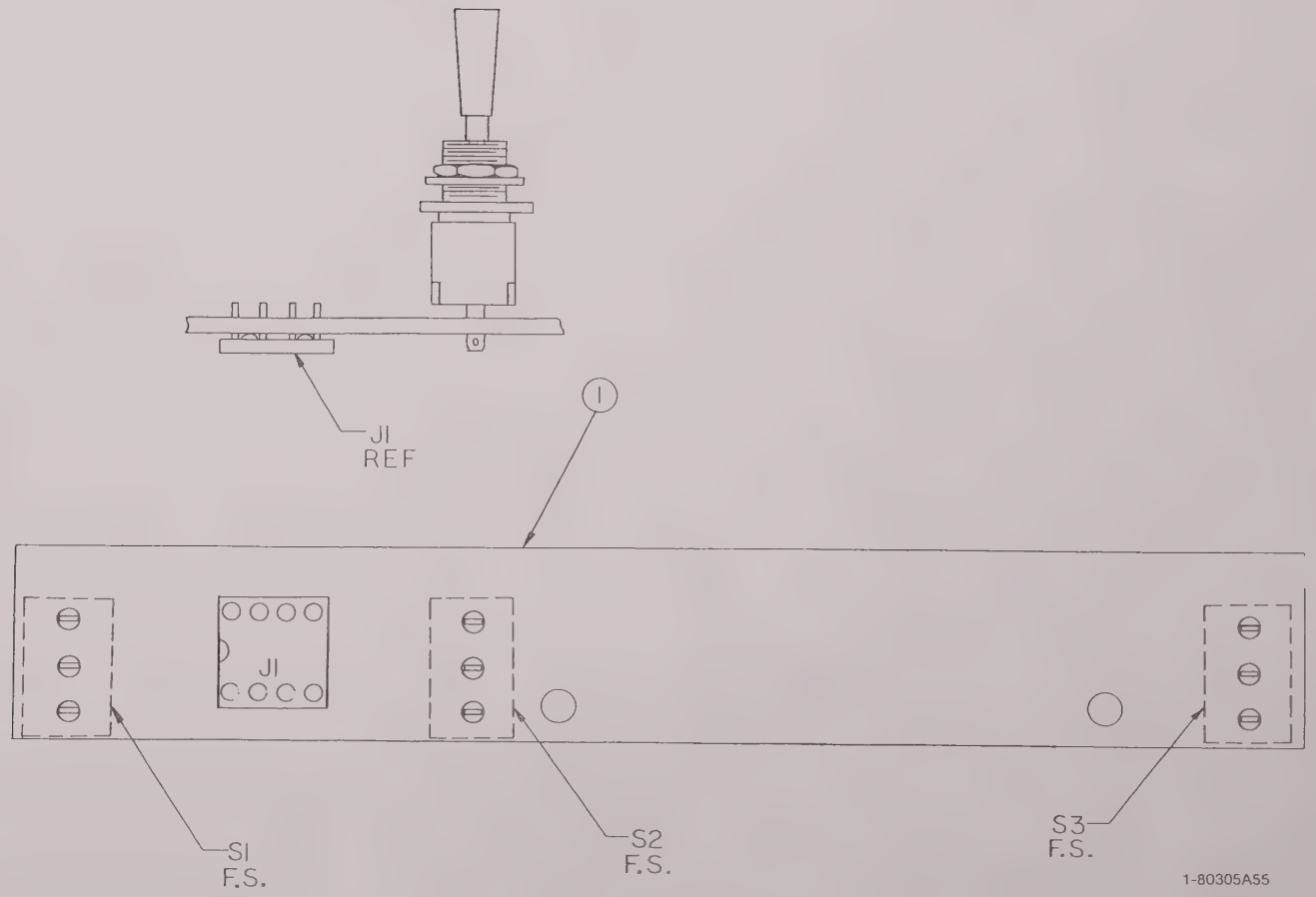



Figure 20-2. Front Panel A14 (01-80305A64) Parts Location Diagram (Sheet 3 of 3)

| Find No. | Qty. Req. | Part No. | Nomenclature | Part Value |
|---|---|---|---|---|
| 001 | 1 | 84-P07844V001 | PWB, DISPLAY | |
| 003 | AR | 11-14167A01 | INK | BLACK |
| 004 | 2 | 583773-4 | SOCKET,12 PIN | |
| 005 | AR | SN63WRMAP3 | SOLDER | |
| 006 | 1 | 1-583773-3 | SOCKET, 6 PIN | |
| 007 | 2 | 43-P06563B007 | SPACER | |
| 008 | 4 | 43-P06563B012 | SPACER | |
| 011 | 2 | B1534-B-1/8-5 | SPACER,SWAGE | |
| 012 | 2 | 03-139581 | SCREW,PH | 4-40X 312 |
| 013 | AR | | COMPOUND,THD LKG,P | TYPE II, GR M, #222 |
| 015 | 1 | 2-583773-0 | SOCKET,24 PIN | |
| 016 | AR | 495-04 | ADHESIVE,FAST CURE | |
| DS001 | 1 | 48-80396A26 | LED | |
| DS002 | 1 | 48-80396A26 | LED | |
| DS003 | 1 | 48-80396A26 | LED | |
| DS004 | 1 | 48-80396A26 | LED | |
| DS005 | 1 | 48-80396A26 | LED | |
| DS006 | 1 | 48-80396A26 | LED | |
| DS007 | 1 | 48-80396A26 | LED | |
| DS008 | 1 | 48-80396A26 | LED | |
| DS009 | 1 | 48-80396A26 | LED | |
| DS010 | 1 | 48-80396A26 | LED | |
| DS011 | 1 | 48-80396A26 | LED | |
| DS012 | 1 | 48-80396A26 | LED | |
| DS013 | 1 | 48-80396A26 | LED | |
| DS014 | 1 | 48-80396A26 | LED | |
| DS015 | 1 | 48-80396A26 | LED | |
| DS016 | 1 | 48-80396A26 | LED | |
| DS017 | 1 | 48-80396A26 | LED | |
| DS018 | 1 | 48-80396A26 | LED | |
| DS019 | 1 | 48-80396A26 | LED | |
| DS020 | 1 | 48-80396A26 | LED | |
| DS021 | 1 | 48-80396A26 | LED | |
| DS022 | 1 | 48-80396A26 | LED | |
| DS023 | 1 | 48-80396A26 | LED | |
| DS024 | 1 | 48-80396A26 | LED | |
| DS025 | 1 | 48-80396A26 | LED | |
| DS026 | 1 | 48-80396A26 | LED | |
| DS027 | 1 | 48-80396A26 | LED | |
| J 001 | 1 | 09 80331A97 | SOCKET SOLDER DIP | 16 PIN |
| J 002 | 1 | 09 80331A97 | SOCKET SOLDER DIP | 16 PIN |
| J 003 | 1 | 09-80331A95 | SOCKET,SOLDER DIP | |
| R 001 | 1 | 6S124A29 | RESISTOR | 150-5-1 4 |
| R 002 | 1 | 6S124A29 | RESISTOR | 150-5-1/4 |
| R 003 | 1 | 6S124A29 | RESISTOR | 150-5-1 4 |
| S 001 | 1 | 40-80396A32 | SWITCH,PUSHBUTTON | 12 POS |
| S 002 | 1 | 40-80369A09 | SWITCH,PUSHBUTTON | 2 POS |
| S 003 | 1 | 40-80369A09 | SWITCH,PUSHBUTTON | 2 POS |
| S 004 | 1 | 40-80369A09 | SWITCH,PUSHBUTTON | 2 POS |
| U 001 | 1 | 51-80345A21 | INTEGRATED CIRCUIT | MC1413P SCREENED |
| U 002 | 1 | 51-80345A21 | INTEGRATED CIRCUIT | MC1413P SCREENED |
| U 003 | 1 | 51-80345A21 | INTEGRATED CIRCUIT | MC1413P SCREENED |
| U 004 | 1 | 51-80345A21 | INTEGRATED CIRCUIT | MC1413P SCREENED |
| U 006 | 1 | 51-80368A49 | INTEGRATED CIRCUIT | MC14514BCP SCREENE |
| U 007 | 1 | 51-80368A49 | INTEGRATED CIRCUIT | MC14514BCP SCREENE |
| U 008 | 1 | 51-80368A49 | INTEGRATED CIRCUIT | MC14514BCP SCREENE |
| U 011 | 1 | 51-80368A41 | INTEGRATED CIRCUIT | MC14059BCP SCREENE |

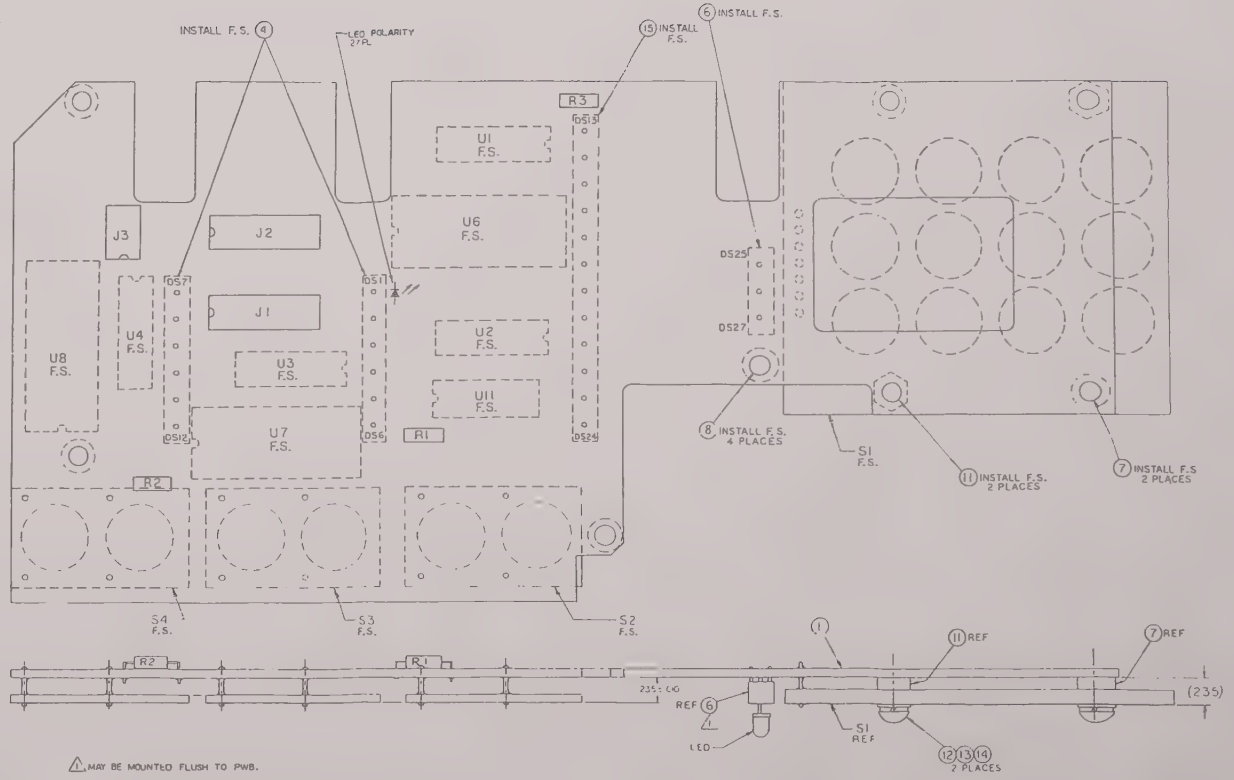



Figure 20-5. Display Board A14A1 (1-80305A63) Parts Location Diagram

# SECTION 21
# IEEE — 488 BUS CONTROL

## 21-1. INTRODUCTION

21-2. The IEEE Interface Option enables the use of the Communications System Analyzer as a programmable measurement instrument. When combined with a suitable programmable controller and applications software, the major functions of the analyzer can be controlled or monitored via an IEEE-488 standard digital interface. Thus, repetitive test routines can be performed and the data recorded quickly and accurately with little operator interaction.

21-3. The interface characteristics conform to the specifications of the IEEE Standard Digital Interface for Programmable Instrumentation (IEEE Standard 488) which defines both the electrical and the mechanical interface. Control protocol is also defined by the specification. Control commands which are unique to the analyzer are described in detail in the following paragraphs of this section.

21-4. The controller for this application should be capable of reading and writing ASCII and control characters from and to the bus in accordance with the 488 specification. Application software is the user's responsibility as dictated by the controller selected, although interface and application assistance is available from Motorola.

21-5. The IEEE option package consists of an IEEE Interface module (A8) with a rear panel connector, an electrically programmable RF attenuator in place of the step attenuator on the RF Input Module (A11), a fourteen position rotary switch on the front panel in place of the step attenuator shaft, and one additional ROM memory IC on the Processor module (A9).

21-6. While in the local mode the IEEE-488 equipped system operates and performs the same as a standard system, except the maximum RF output level is reduced to +11 dBm from +13 dBm. However, when the Remote Enable (REN) line on the IEEE Bus is activated many of the front panel controls are disabled and their functions placed under bus control. Refer to table 21-1 for a listing of those functions which can be controlled or monitored via the 488 Bus.

Table 21-1. IEEE 488 Interface Controllable Functions

| Control/Measurement | Comment |
|---|---|
| Function Switch | Generate/Power Monitor/ Monitor |
| Modulation Control | Continuous/OFF/BURST |
| Wideband/Narrowband Switch | |
| Image High/Low Switch | |
| Duplex Oscillator Switch | 0-10 MHz/OFF/45 MHz |
| Keyboard | Numeric Entries 0-9<br>Can be transmitted to the bus. |
| Display Mode | Generate/Monitor<br>Metering (Note: 1)<br>Modulation<br>Spectrum Analyzer<br>Duplex Generator<br>RF Memory<br>Tone Memory<br>Frequency Counter<br>DVM<br>External Wattmeter<br>IF<br>Scope AC<br>Scope DC<br>Remote Terminal Mode<br>Unit can also display a subset of ASCII characters (numerals 0-9, upper case alpha letters A-Z, plus other symbols—ASCII characters 20 thru 5F Hexadecimal) enables display of operator messages on CRT display in a transparent terminal mode |
| Function Mode | FM (Note: 1)<br>CW<br>AM<br>SSB/DSB<br>SWP 1-10 MHz<br>SWP 0 01-1 MHz |
| Code Synthesizer Mode | PL/DPL<br>PL/DPL Invert<br>Tone A<br>Tone B<br>Tone Sequence<br>Tone Remote |

| Control/Measurement | Comment |
|---|---|
| RF Frequency<br>PL Frequency<br>DPL Code<br>Tone A Frequency<br>Tone B Frequency | Frequency entry to be supplied by program<br>Frequencies not available from memory table |
| Time Sequence Select | Sequences 1 through 5 only (Note: 2) |
| Wattmeter Element Select | |
| External Modulation | Modulation settable to any measurable level |
| Code Synthesizer Modulation | (0-20 KHz deviation in 10 Hz steps) (Note: 3)<br>(0-90% AM in 0 1% steps) |
| RF level | RF level settable to any displayable level (- 127 to +11 dBm in 0 1 dBm steps (Note: 3) (Note: 4) |
| Scope Vertical Step Attenuator | 0 01, 0 1, 1, 10 volts |
| Horizontal Scope Sweep | 1, 10. 100 milliseconds<br>1, 10. 100 microseconds<br>External |
| Input Power Meter<br>Frequency Error<br>Deviation + or -<br>% AM + or -<br>SINAD<br>External DVM (AC or DC)<br>External Frequency Count<br>External Power Meter FWD/REV | Reading returned as displayed on screen (Note: 3) |

Notes: (1) May be affected by other controls (see below)
(2) Sequence 5 timing is programmable under IEEE bus control
(3) As reading is displayed, LED corresponding to appropriate display and function mode will illuminate
(4) The IEEE-Bus option, due to a change in the RF step attenuator, restricts the maximum RF output to +11 dBm

## NON-CONTROLLABLE FUNCTIONS

Since control and monitor functions of the interface are implemented to obtain remote measurement capability, certain front panel controls are not implemented in the interface due to their local operator orientation. A list of these operator oriented controls are as follows:

- Power On/Off
- Power Mode Indicators
- Display Focus
- Display Intensity
- Dispersion/Sweep
- Scope/DVM Vertical Vernier
- Scope Trigger Level
- Scope Trigger Slope
- Scope Horizontal Sweep Vernier
- Scope Vertical Position
- Scope Horizontal Position
- Receiver Squelch
- Receiver Volume
- Zero Beat Indicator
- RF Scan
- RF Memory Table
- Tone Sequences, 6, 7, and 8 Entries
- Deviation Limit
- Battery Voltage Reading
- Deviation Limit Alarm (Disabled Under Remote Control)
- Attenuator 0 Indicator
- Battery Below Limit Warning
- BFO Frequency Adjust
- Offset Oscillator Adjust

8521-66

## 21-7. IEEE-488 BUS STRUCTURE

21-8. The following discussion briefly describes the 488 Bus operation. It is not a complete definition of the total bus structure or capability. For complete information a copy of IEEE Standard 488 should be obtained.

**21-9. Bus Signals.** The IEEE-488 Bus consists of 16 parallel lines. The lines are divided into three groups. Lines D101-D108, Data Input Output, form the 8-bit data bus for the bidirectional transfer of control and ASCII characters. Three handshake lines, Data Valid (DAV), Not Ready for Data (NRFD), and Not Data Accepted (NDAC), control the transfer of data on the data bus. The remaining five lines can be termed the bus management lines with functions as follows:

| | |
|---|---|
| Attention (ATN) | — When true the data bus carries an address or a command when false it carries data. |
| Interface Clear (IFC) | — When true all devices on the bus are placed in a known quiescent state. |
| Service Request (SRQ) | — Indicates a device on the bus needs service. |
| Remote Enable (REN) | — Enables the remote control feature of the devices on the bus. |
| End or Indentify (EOI) | — Indicates the end of a multiple byte transfer. |

**21-10. Data Transfer.** Each byte of data that is transferred across the data bus is synchronized with a handshaking procedure. This procedure allows devices with different data transfer rates to share the same bus. The handshake cycle starts when the source device which has data to transfer checks for a false condition on the NRFD line. When NRFD is false, all devices on the bus are ready to accept data. The source then puts the data onto the data bus and sets the DAV to its true state. The acceptor devices inputs the data, sets the NRFD line to its true state, and when ready set the NDAC line to its false state. Because the NRFD and NDAC lines are wire-ORed the line will not go to the false state until all devices on the bus have released the line. Thus the slowest device on the bus determines the transfer rate. When the NDAC line goes false the source devices set the DAV false which in turn causes the acceptor devices to set the NDAC line true. When the acceptor devices have completed processing the data byte just received they allow the NRFD line to go to the false state completing the handshake. As the data transfer contines the cycle repeats for each data byte.

21-11. Bus Address. Each device on the bus is assigned a four bit address by the programmer. The address assigned to the device is set by an address switch within the device. On the analyzer the address switch is on the IEEE Interface Module. Only the top four switches are used to set the address. The fifth switch is unused. To set the address use the binary equivalent of the address number and set the switches to the ON position for a logic 1. The least significant bit is the top switch.

## 21-12. Programming

21-13. Programming the system analyzer consists of first addressing the unit as a listener, transferring the control commands to the unit, and then sending a command termination sequence. To obtain data from the system, the pertinent control commands are first transferred to the unit and then the unit is addressed as a talker. As a talker the system outputs onto the bus the data requested by the control commands.

21-14. The bus controller is the central part of the automatic system. The program, consisting of sequences of analyzer control commands and sequences of controller instructions for handling the return data, is contained within the controller. The user must initially write the program so that the desired test sequences and data outputs will be obtained. The following paragraphs define the instruction set and data formats that can be used to control or will be returned from the system analyzer. The user must insure that the controller is compatible with the IEEE-488 Standard bus and that its program is correct for the instruments on the bus.

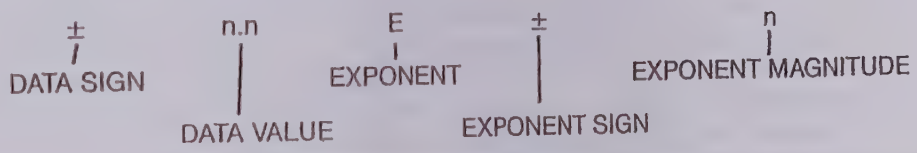
**21-15. Command Structure.** Each command consists of a two letter definition prefix followed by a numeric data field. The data field will vary in length and structure according to the definition prefix as shown in table 21-3. Spaces may be inserted anywhere in the command but are not required. Each letter or number of a command is transferred from the bus controller to the analyzer in ASCII format. ASCII defines a 7-bit digital code for each letter, number, and symbol commonly used in computer programming.

21-16. The first letter of the two letter prefix identifies a command category with the second letter identifying a particular command within that category. A listing of the command categories and the corresponding first letter is provided in table 21-2. A complete list of commands is shown in table 21-3.

Table 21-2. Command Categories

| | |
|---|---|
| A | Audio Synthesizer |
| C | Control |
| F | Frequency Counter |
| G | Generate/Monitor Control |
| K | Keyboard |
| M | Modulation |
| O | Oscilloscope |
| R | Receiver |
| V | Voltmeter/Distortion Analyzer |
| W | Wattmeter |

21-17. The data field is comprised of five sub-fields as shown:




Data limits and accompanying units are given in table 21-3. The data field is optional or not allowed for certain commands.

21-18. Data Sign. The data sign is a single '+' or '−' character indicating the sign of the data value. The sign may be omitted for positive value data.

21-19. Data Value. The data value field is restricted to the numbers '0' through '9' and '.'. A maximum of five digits to the right and to the left of the decimal point are allowed. The decimal point can be omitted for integer values. If the value field is omitted, it is assumed to be zero.

21-20. Exponent. The presence of the "E" character in the exponent field indicates that the data value is to be multiplied by 10 raised to the power following the "E" character. If the "E" is omitted the exponent is assumed to be $10^0$ or 1.

21-21. Exponent Sign. The exponent sign is a single + or − character and can be omitted for positive exponent values.

21-22. Exponent Magnitude. The exponent magnitude is a single character 0 through 9. If the exponent magnitude is omitted, it is assumed to be zero.

Table 21-3 Programming Commands

| | Data | Units | Type | Function | Changes to Display | Changes to Function | Changes to Mode |
|---|---|---|---|---|---|---|---|
| | | | | **AUDIO GENERATOR** | | | |
| AA | 0-9999.9 | Hz | D | Tone A Frequency | | | |
| AB | 0-9999.9 | Hz | D | Tone B Frequency | | | |
| AP | 0-999.9 | Hz | D | PL Frequency | | | |
| AD | 0-777 | — | D | DPL Code | | | |
| AF | X-XXXXX | — | D | 5/6 Tone Number | | | |
| AM | 1-4 | — | D | Tone Mode Select | | | |
| AT | XXXXXXX | — | D | Telephone Number | | | |
| AV | XXXX | — | D | Select V Tone Number | | | |
| AS | 1-5 | — | D | Tone Sequence Select | | | |
| | | | | For AM = 1 (A/B) | | | |
| | | | | 1 Tone | | | |
| | | | | 2 Tn → Vce | | | |
| | | | | 3 Var 1 | | | |
| | | | | 4 Var 2 | | | |
| | | | | For AM = 2 (5/6) | | | |
| | | | | 1 5 Tone | | | |
| | | | | 2 6 Tone | | | |
| | | | | For AM = 3 (Mobile Tel) | | | |
| | | | | 1 IMTS | | | |
| | | | | 2 MTS | | | |
| | | | | 3 2805 | | | |
| | | | | For AM = 4 (Sel V) | | | |
| | | | | 1 ZVE1 | | | |
| | | | | 2 Modified ZVE1 | | | |
| | | | | 3 CCIR (70 ms) | | | |
| | | | | 4 CCIR (100 ms) | | | |
| | | | | 5 EEA | | | |
| AW | 0-9.99 | SEC | D | A ON User Seq. (AS = 3) | | | |
| AX | 0-9.99 | SEC | D | A OFF User Seq. (AS = 3) | | | |
| AY | 0-9.99 | SEC | D | B ON User Seq. (AS = 3) | | | |
| AZ | 0-9.99 | SEC | D | B OFF User Seq. (AS = 3) | | | |
| | | | | **CONTROL** | | | |
| CD | 0-12 | — | C | Display Select<br>0 Gen-Mon Mtr<br>1 Modulation<br>2 Spect Analyzer<br>3 Duplex Gen<br>4 RF Mem<br>5 Tone Mem<br>6 Freq Counter<br>7 DVM<br>8 Ext Wattmeter<br>9 IF<br>10 Scope AC<br>11 Scope DC<br>12 Terminal | 1 | | |
| CF | 0-5 | — | C | Function Select<br>0 FM<br>1 CW<br>2 AM<br>3 SSB/DSBSC<br>4 SWP 1-10 MHz<br>5 SWP 0.01-1 MHz | | 1 | |
| CG | — | — | C | Generate Mode | | | GEN |
| CM | — | — | C | Monitor Mode | | | MON |
| CP | — | — | C | Power Monitor Mode | | | PWR MON |

Table 21-3 Programming Commands (Cont)

| Prefix | Data | Units | Type | Function | Changes To Display | Changes To Function | Changes To Mode |
|---|---|---|---|---|---|---|---|
| | | | | **FREQUENCY COUNTER** | | | |
| FC | 0-35000 | kHz | O | External freq count | 2 | | |
| | | | | **GENERATE/MONITOR** | | | |
| GF | 0-999.9999 | MHz | D | Generate/Monitor Frequency | | | |
| GL | -130.0 to +13.0 | DBM | C | Generate RF Level | | | GEN |
| | | | | **KEYBOARD** | | | |
| K1 | 0-127 | — | D | Display Up Key Data | | | |
| K2 | 0-127 | — | D | Display Down Key Data | | | |
| K3 | 0-127 | — | D | Function Up Key Data | | | |
| K4 | 0-127 | — | D | Function Down Key Data | | | |
| K5 | 0-127 | — | D | Mode Up Key Data | | | |
| K6 | 0-127 | — | D | Mode Down Key Data | | | |
| | | | | **MODULATION** | | | |
| MB | — | — | C | Modulation Burst | | | |
| MC | — | — | C | Modulation Continuous | | | |
| MO | — | — | C | Modulation Off | | | |
| MM | 0-5 | — | C | Modulation Mode<br>0 PL/DPL<br>1 PL/DPL div<br>2 Tone A<br>3 Tone B<br>4 Tone Sequence<br>5 Tone Remote | | | |
| ME | 0-99.9 | kHz (FM) % (AM) | C | External Mod Level | | 3 | GEN |
| MK | 0-99.9 | kHz (FM) % (AM) | C | 1 kHz Mod Level | | 3 | GEN |
| MS | 0-99.9 | kHz (FM) % (AM) | C | Code Synthesizer Mod Level | — | 3 | GEN |
| | | | | **OSCILLOSCOPE** | | | |
| OH | 0-6 | — | C | Horizontal Sweep Select<br>0 1 micro sec/div<br>1 10 micro sec/div<br>2 100 micro sec/div<br>3 1 milli sec/div<br>4 10 milli sec/div<br>5 100 milli sec/div<br>6 External | | | |
| OD | 0-9.999 | SEC | D | Trigger Delay | | | |
| OV | 0-3 | — | C | Vertical Gain Select<br>0 10 V/div<br>1 1 V/div<br>2 0.1 V/div<br>3 0.01 V/div | | | |

Table 21-3 Programming Commands (Cont)

| Prefix | Data | Units | Type | Function | Changes To Display | Changes To Function | Changes To Mode |
|---|---|---|---|---|---|---|---|
| | | | | **RECEIVER** | | | |
| RH | — | — | C | High Image | | | |
| RL | — | — | C | Low Image | | | |
| RN | — | — | C | Narrow band | | | |
| RW | — | — | C | Wide band | | | |
| RA | 0-13 | 10's dB | C | Receive Mode Step Attenuator Setting<br>0 0 dB<br>1 10 dB<br>1 10 dB<br>1 10 dB<br>13 130 dB | | | |
| RE | 0-100 | — | O | Receive frequency error | 4 | | MON |
| RP | 0-1 | — | O | Signal Presence Indication<br>0 No signal<br>1 Signal present | | | MON |
| R- | 0-99.99 | kHz | O | Minus Deviation | 4 | FM | MON |
| R+ | 0-99.99 | kHz | O | Plus Deviation | 4 | FM | MON |
| R< | 0-99.99 | % | O | Minus % AM | 4 | AM | MON |
| R> | 0-99.99 | % | O | Plus % AM | 4 | AM | MON |
| | | | | **VOLTMETER** | | | |
| VA | 0-300 | VOLTS | O | DVM AC | 5 | | |
| VD | 0-300 | VOLTS | O | DVM DC | 5 | | |
| VP | 0-99.9 | % | O | Distortion Reading | 5 | | |
| VS | 0-40.0 | dB | O | Sinad Reading | 4 | 6 | GEN |
| | | | | **WATTMETER** | | | |
| WE | 1-9 | — | D | Wattmeter element number<br>1 2.5 W<br>2 5 W<br>3 10 W<br>4 25 W<br>5 50 W<br>6 100 W<br>7 250 W<br>8 500 W<br>9 1000 W | | | |
| WI | 0-132.0 | WATTS | O | Internal Wattmeter reading | 4 | | PWR MON |
| WF | 0-1000 | WATTS | O | Forward External Wattmeter Reading | 7 | | |
| WR | 0-1000 | WATTS | O | Reverse External Wattmeter Reading | 7 | | |

Notes:
1. Display is defined by the data
2. External Frequency Counter Display
3. FM if not AM
4. Gen/Mon Mtr Display
5. DVM Display
6. FM if in DSBSC or SWEEP
7. External Wattmeter Display

21-23. The following are examples of correct data fields for the value 12.34:

| | | | |
|---|---|---|---|
| 0.1234 E+2 | +0.1234 E2 | 1234 E-2 | 1234.E-2 |
| +12.34 | 12.34E | +1234 E-2 | 12.34 E0 |

**21-24. Command Strings.** A command string consists of either a single command or multiple commands in succession with or without embedded spaces. A command string must be terminated with a carriage return and a line feed character.

**21-25. Command Types.** Each command is one of three basic types, control selects (C), data entry (D), and output requests (O). Type information for each command is listed in table 21-3.

21-26. Control Selects. Control select commands select front panel switch settings. Some of these commands do not require accompanying data, such as toggle switch commands.

21-27. Data Entry. Data entry commands replace manual entry of data through the keyboard. All of these commands require data in the data field.

21-28. Output Requests. Output request commands allow data that is normally displayed on the CRT to be transferred to the controller. Accompanying data is not required with output requests. The data limits and units listed in table 21-3 for these commands refer to the return data. Output request commands cause the analyzer to go to the proper display, function, and mode to acquire the designated reading. These states are listed in table 21-3. The measurement however, is not made until a trigger command 'T' has been sent from the controller. The trigger command causes the measurement to be made and the data held for transmission to the controller. Then when the controller addresses the analyzer as a talker the data is output to the controller. A reading can be retaken for any number of triggers without repeating the output request. The request is lost however, when any command changing the display, function, or mode is sent.

**21-29. Trigger Command.** The trigger command is the exception to the two character command prefix. This command is simply the letter 'T' usually sent immediately following the output request command. If no output request is pending, the trigger command is ignored.

**21-30. Return Data.** The data returned from the analyzer is formatted similar to the control data as shown.

DATA SIGN (+) DATA VALUE (n) EXPONENT SIGN (E) EXPONENT MAGNITUDE (n)

The data is always returned in this format with a single exception. Data for the "RP", signal present, command is returned as a single digit having a value of "0" or "1".

21-32. Data Value. The data value is 1 to 5 digits in length with leading zero suppression and no decimal point.

21-33. Exponent and Exponent Sign. The letter 'E' followed by a '—' character is always transmitted with return data.

21-34. Exponent Magnitude. The exponent magnitude is a single digit with a value from 0 to 9. The digit indicates the negative power of ten that is to be multiplied with the data value to obtain the units listed in table 21-3.

**21-35. Programming Commands.** Table 21-3 lists the programming commands available for the system analyzer. The table identifies the category and type of command, the data limits and units, the command function, and ar display, function, or mode change that would occur.

**21-36. Terminal Mode.** When the command 'CD12' is used, the system terminal mode is enabled. The terminal mode allows the analyzer's CRT display and keyboard to perform as a limited function I/O terminal. Possible uses for the terminal mode would be to provide test instructions to a test operator at an auto test station.

21-37. Display Format. Once the 'CD12' command has been sent the terminal mode has been entered. All further ASCII valid characters sent from the controller will appear on the CRT display. The total display area on the CRT is 15 lines of 30 characters each. Character entry on the CRT is on the bottom line. Each line feed character causes the bottom line to move up one place. If more than 30 lines are entered, the top lines are lost off the top of the display. A list of valid ASCII characters for the display is provided in table 21-4. All invalid characters are ignored in the terminal mode.

21-38. Keyboard Entry. In the terminal mode the keyboards on the analyzer may be used to input data to the bus controller. The ten numeric keys and the left cursor key have predefined ASCII characters. The character corresponds to the number on the key for the numeric keys. For the left cursor key, carriage return and line feed characters are sent. The down cursor key causes a bus service request to be generated regardless of the operating mode. This key could be used to halt an automatic test sequence.

21-39. The remaining pushbuttons are defined, prior to entering the terminal mode, with the use of the keyboad control commands listed in table 21-3. Each key is assigned an ASCII character by following the Kn command prefix with the decimal equivalent of the binary ASCII code for that character. A list of valid ASCII characters and their binary and decimal equivalents are listed in table 21-4.

21-40. Data that is entered from the keyboard is stored in a 9 character buffer until addressed by the bus controller If more than 9 keypresses occur before the controller accesses the analyzer, the excess inputs are lost. Once the controller has addressed the analyzer, the analyzer transmits the character data to the controller. The analyzer will continue to transmit, or hold up the bus handshake if no keys have been pressed, until the left cursor key is pressed. Thus every data string entry from the keyboard must terminate with the left cursor key. As the data is transmitted to the controller it is also entered onto the CRT display.

21-41. Terminal Mode. Exit. An ASCII end of transmission character (EOT) sent from the controller will terminate the terminal mode. When the mode is terminated the analyzer returns to the Gen/Mon Mtr display, and is ready to accept new command inputs.

**21-42. Error Messages.** Error messages are generated by the analyzer to help the programmer troubleshoot his program. As control commands are received by the analyzer, they are decoded to determine the command sent. If the analyzer is unable to decode the command it generates an error message and ignores all succeeding commands. To clear the error condition the bus controller must address the analyzer as a talker so that the error message will be transferred to the controller.

Table 21-4. Terminal Mode ASC II Characters Printable Characters

| ASCII Char. | Equivalent Binary | Hex | Dec | ASCII Char. | Equivalent Binary | Hex | Dec |
|---|---|---|---|---|---|---|---|
| SP | 00100000 | 20 | 32 | @ | 01000000 | 40 | 64 |
| ! | 00100001 | 21 | 33 | A | 01000001 | 41 | 65 |
| " | 00100010 | 22 | 34 | B | 01000010 | 42 | 66 |
| # | 00100011 | 23 | 35 | C | 01000011 | 43 | 67 |
| $ | 00100100 | 24 | 36 | D | 01000100 | 44 | 68 |
| % | 00100101 | 25 | 37 | E | 01000101 | 45 | 69 |
| & | 00100110 | 26 | 38 | F | 01000110 | 46 | 70 |
| ' | 00100111 | 27 | 39 | G | 01000111 | 47 | 71 |
| ( | 00101000 | 28 | 40 | H | 01001000 | 48 | 72 |
| ) | 00101001 | 29 | 41 | I | 01001001 | 49 | 73 |
| * | 00101010 | 2A | 42 | J | 01001010 | 4A | 74 |
| + | 00101011 | 2B | 43 | K | 01001011 | 4B | 75 |
| , | 00101100 | 2C | 44 | L | 01001100 | 4C | 76 |
| - | 00101101 | 2D | 45 | M | 01001101 | 4D | 77 |
| . | 00101110 | 2E | 46 | N | 01001110 | 4E | 78 |
| / | 00101111 | 2F | 47 | O | 01001111 | 4F | 79 |
| 0 | 00110000 | 30 | 48 | P | 01010000 | 50 | 80 |
| 1 | 00110001 | 31 | 49 | Q | 01010001 | 51 | 81 |
| 2 | 00110010 | 32 | 50 | R | 01010010 | 52 | 82 |
| 3 | 00110011 | 33 | 51 | S | 01010011 | 53 | 83 |
| 4 | 00110100 | 34 | 52 | T | 01010100 | 54 | 84 |
| 5 | 00110101 | 35 | 53 | U | 01010101 | 55 | 85 |
| 6 | 00110110 | 36 | 54 | V | 01010110 | 56 | 86 |
| 7 | 00110111 | 37 | 55 | W | 01010111 | 57 | 87 |
| 8 | 00111000 | 38 | 56 | X | 01011000 | 58 | 88 |
| 9 | 00111001 | 39 | 57 | Y | 01011001 | 59 | 89 |
| : | 00111010 | 3A | 58 | Z | 01011010 | 5A | 90 |
| ; | 00111011 | 3B | 59 | [ | 01011011 | 5B | 91 |
| < | 00111100 | 3C | 60 | \ | 01011100 | 5C | 92 |
| = | 00111101 | 3D | 61 | ] | 01011101 | 5D | 93 |
| > | 00111110 | 3E | 62 | ^ | 01011110 | 5E | 94 |
| ? | 00111111 | 3F | 63 | _ | 01011111 | 5F | 95 |

NON-PRINTING CHARACTERS

| ASCII Char. | Equivalent Binary | Hex | Dec |
|---|---|---|---|
| EOT* | 00000100 | 04 | 4 |
| BELL | 00000111 | 07 | 7 |
| BSP | 00001000 | 08 | 8 |
| LF | 00001010 | 0A | 10 |
| CR | 00001101 | 0D | 13 |

*causes exit from terminal mode

21-43. The format of the erorr message is:

ERROR nn (CR)(LF)

The two digit number nn defines the error condition as listed in table 21-5. The carriage return (CR) and line feed ( characters are the termination sequence used by analyzer whenever it transmits information. All characters are ASC II coded.

Table 21-5. Error Messages

| Error Code | Condition |
|---|---|
| 00 | Data requested without trigger |
| 01 | Invalid mnemonic prefix |
| 02 | One character mnemonic (not T) |
| 03 | Invalid mnemonic suffix |
| 04 | Exponent overflow |
| 05 | Data underflow |
| 06 | Data overflow |
| 07 | Data transmitted, not allowed |
| 08 | Invalid data |
| 09 | RF input power exceeded |
| 10 | Level or mod control error |

21-44. To effectively utilize the error message capability of the analyzer it is necessary to address the unit as a talker after the transmission of each command string. The bus controller must then be programmed to recognize the error message and to decode the error number. A successful data transmission will send back an error code 00 when addressed as a talker. The controller should be programmed to ignore error 00 and to display any other error to the operator. Of course if a valid output command followed by the trigger command was sent, the talker address will result in the requested data being output to the controller.

**21-45. Service Requests.** There are only two conditions that will cause the analyzer to generate a service reques (SRQ) on the bus. If a SRQ is generated it must be cleared by a serial poll of the analyzer. The serial poll is a bus command which results in a data byte being sent to the controller from the analyzer. The data byte indicates the cause of the SRQ. Table 21-6 lists the SRQ causes and the corresponding serial poll data.

Table 21-6. SRQ Data

| Condition | Return Data | | |
|---|---|---|---|
| | Binary | HEX | DEC |
| Depressing Cursor Down Key | 01000001 | 41 | 65 |
| RF load over Temperature | 01000010 | 42 | 66 |

**21-46. Programming Considerations.** The flexibility of the IEEE-488 option is reflected in the number of programming commands. To use these effectively and efficiently, certain programming practices should be followed. The following paragraphs present the major considerations for effective programming.

21-47. Generate Mode. For accurate level control it is best to specify the generate frequency prior to the RF output level. For example, the command string:

CGGFIOOGL5

sets the generate mode, a frequency of 100 MHz and an output level of +5 dBm.

21-48. Code Synthesizer. Before enabling the output of the code synthesizer with an MS, ME, or MK command, all the necessary parameters must first be defined. Table 21-7 lists the modes and their controlled parameters that need to be defined. It should be noted that these parameters do not need to be defined each time a mode is selected, only when they are to be changed for that mode.

Table 21-7. Code Synthesizer Programming Considerations

| Output | Command String | Effect |
|---|---|---|
| DPL Code | CFOAD131MM0MS3 | FM, DPL Code 131, 3 kHz FM |
| DPL Inverted Code | CFAD313MM1MS5 | FM, DPL Code 313, 5 kHz FM |
| PL Code | CF2AP60.5MMMS30 | AM, PL-60.5 Hz, 30% AM |
| Tone A | CFAA2E3MM2MS3 | FM, 2000 Hz, 3 kHz FM |
| Tone B | CFAB2000MM3MS3 | FM, 2000 Hz, 3 kHz FM |
| Tone Remote | CFAA1.5E3AB300MM5MS3 | FM, A = 1500 Hz, B = 300 Hz, 3 kHz FM |
| A/B Standard Sequence | CFAS4AA1E3AB2E3MM4MS3 | FM, Sequence 4, A = 1 kHz, B = 2 kHz, 3 kHz FM |
| A/B User Sequence | CFAS5AA1E3AB2E3AW1 | FM, Sequence 5, A = 1 kHz, B = 2 kHz |
| | AX1AY1AZ1MM4MS3 | 1 sec on/off times, 3 kHz FM |

21-49. Modulation. The system analyzer is capable of modulating with three simultaneous sources. The commands ME, MK, and MS only affect their individual portion of the total output. Thus to avoid inadvertently having an unwanted modulation source enabled it is recommended that all three source values be defined together. For example:

CFMKMSME20

selects the FM mode, disables the 1 kHz and code synthesizer modulation, and set 20 kHz deviation from the external input. The external input must be applied to the analyzer prior to sending this command.

21-50. For the generate AM mode the frequency and output level must be defined prior to selecting the modulation level. The following command string is of the proper sequence to obtain 30% AM at 100 Mz with a level of −100 dBm:

CGGF100GL-100MEMSMK30

21-51. The bandwidth control commands, RN and RW, range the generate FM modulator sensitivity. For greater resolution and faster set up time for deviations less than 20 kHz use the narrowband 'RN' command. Above 20 kHz deviation the wideband 'RW' command must be used.

21-52. Measurements. To obtain correct monitor mode data it is necessary to first set the frequency, bandwidth, and image prior to making the reading. Thus, it is a good practice to always place the request for a reading as the last command in the string. For example the command string:

CMRNRHGF95.5RET

selects the monitor mode, narrowband, high image, and 95.5 MHz center frequency. The 'RET' command asks for a frequency error reading and triggers the analyzer so that the reading will be made.

**21-53. General.** Overall, programming the analyzer involves the same steps as are involved when using it manually. A program can be fairly easily obtained by first performing the desired test sequence manually noting each time a setting is changed and a reading made. The program is then simply a duplication of the manual steps with control commands substituted.

### 21-54. R2002C Analyzer Configuration

The R2002C analyzer differs in configuration from the standard R2001C in the following manner:

A11 Module: The manual attenuator AT1 is replaced with a programmable version (P/N RTL-4064A) A new ribbon cable assembly connected to the A8 module provides control signals for the attenuator. The module is reidentified for ordering purposes as RTC-1003C.

A9 Module: Additional memory for the IEEE program is added by adding U36 (E-PROM TMS 25L32).

Front Panel Assembly A14: Rotary switch S19 is added for control of the RF Input/Output level. The switch P/N is 40-P04127T001.

Module A8 is added to the analyzer (see Section 14 for details). Ribbon cable assembly 30-P04147T001 is added from the A8 module to the rear panel of the analyzer to provide I/O signals.

The items that require clarification relate to the code synthesizer functions and modify paragraphs 21-48 thru 21-50 as follows:

1. Always select a tone mode before selecting a tone sequence, i.e: select an AM before selecting AS (table 21-7, last five examples are in error)

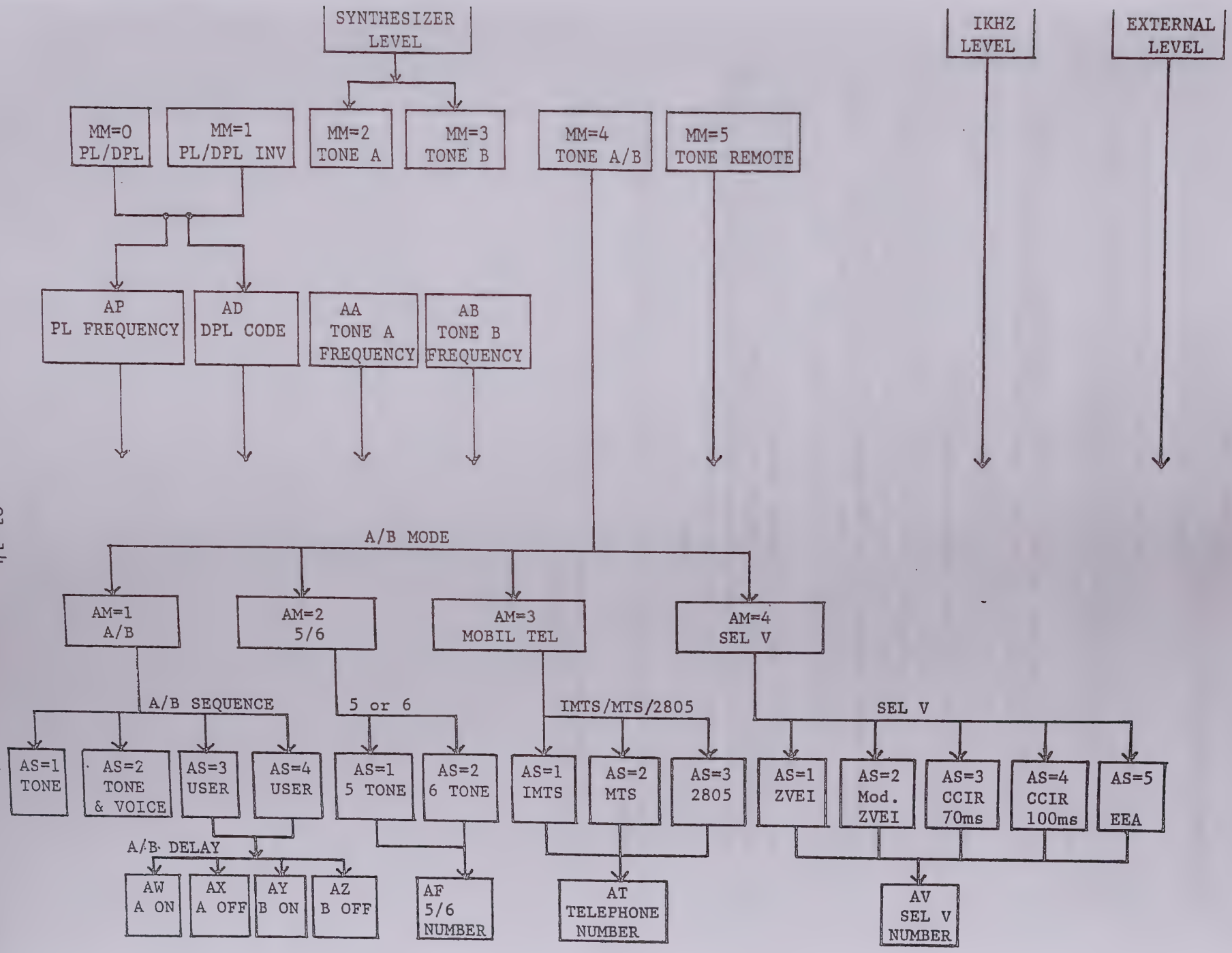
2. Use AS3 or AS4 to select A/B delay (AW, AX, AY, AZ). AS5 is no longer available (table 21-7, last example is in error).

3. To set up a code synthesizer level (AM depth or FM deviation) with the MS command it is necessary to select tone A or tone B first (MM2 or MM3). Therefore, always request MM2 or MM3 before setting up a level with the MS command. If a tone sequence is desired, follow the MS command with an MM4 or MM5.

4. When selecting AM3 (mobile telephone sequence) it is not possible to modify the frequency of the tones with the AA or AB commands. The frequency of the tone can only be changed through manual entry. When the analyzer is powered up, the frequency of the tone is whatever was last entered manually and retained in the non-volatile memory.

5. The analyzer now recognizes lower case letters in terminal mode and in commands.

6. The following chart is enclosed to clarify the various functions available with the new code synthesizer.


SYNTHESIZER LEVEL
IKHZ LEVEL
EXTERNAL LEVEL
MM=0 PL/DPL
MM=1 PL/DPL INV
MM=2 TONE A
MM=3 TONE B
MM=4 TONE A/B
MM=5 TONE REMOTE
AP PL FREQUENCY
AD DPL CODE
AA TONE A FREQUENCY
AB TONE B FREQUENCY
A/B MODE
AM=1 A/B
AM=2 5/6
AM=3 MOBIL TEL
AM=4 SEL V
A/B SEQUENCE
5 or 6
IMTS/MTS/2805
SEL V
AS=1 TONE
AS=2 TONE & VOICE
AS=3 USER
AS=4 USER
AS=1 5 TONE
AS=2 6 TONE
AS=1 IMTS
AS=2 MTS
AS=3 2805
AS=1 ZVEI
AS=2 Mod. ZVEI
AS=3 CCIR 70ms
AS=4 CCIR 100ms
AS=5 EEA
A/B DELAY
AW A ON
AX A OFF
AY B ON
AZ B OFF
AF 5/6 NUMBER
AT TELEPHONE NUMBER
AV SEL V NUMBER

# MOTOROLA BATTERY PACK

MODEL RTP-1002A

## 1. DESCRIPTION

The RTP-1002A is a battery pack and charger designed to be mounted to the back of the R-2001A Communications System Analyzer. The unit contains battery capacity to operate the R-2001A for approximately one hour. A constant current charging system is capable of recharging the batteries in 16 hours.

## 2. INSTALLATION

2.1 The RTP-1002A Battery Pack is quickly installed on the R2001A/B/C Communication System Analyzer. With the R2001 disconnected from the AC line, remove the blower AC connector from the socket on the rear panel of the unit. For R2001A units only, remove six screws holding the blower assembly to the rear of the unit. Lift the blower assembly from the rear panel and set it aside. Replace the six screws in their holes to avoid loss. For R2001B/C units, loosen the two thumbscrews and move the two clips aside that hold the blower to the rear panel. Lift the blower off and set it aside, noting the position of the blower in relation to the two locating pins on the rear panel. Reverse this procedure to reinstall the blower. Please affix caution label (P/N 54-80379A76) to the rear panel of your R-2001.

2.2 Place the tabs on the left edge of the RTP-1002A Battery Pack into the slots in the left feet on the rear panel of the R2001. Two captive screws on the right edge of the battery pack engage threaded holes in the right feet on the rear panel. Tighten these screws snugly, but do not overtighten. Install the cable from the battery pack into the DC IN jack on the R2001 rear panel, and reconnect the AC line cord.

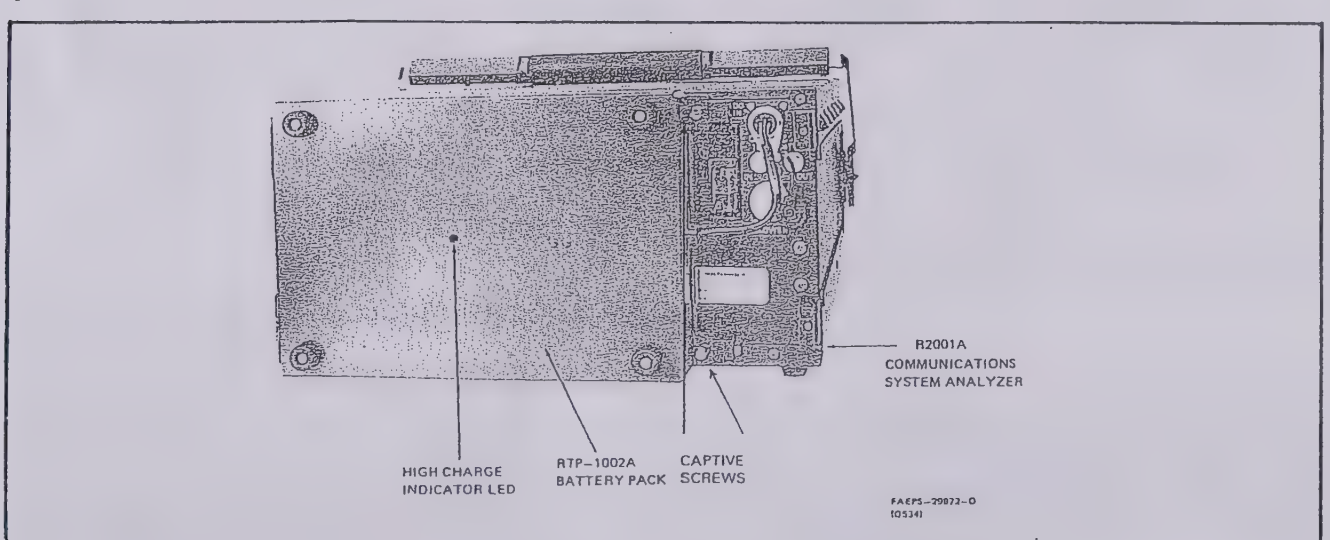
## 3. OPERATION

3.1 The RTP-1002A Battery Pack is automatically engaged when no ac power is present, and the power switch is either in the ON or STANDBY positions. When ac power is applied, the R-2001A automatically switches the RTP-1002A Battery Pack out of the circuit and draws its power from the ac power source.

3.2 When the power switch is in the OFF or STANDBY position and ac power is applied to the R-2001A, the RTP-1002A Battery Pack draws dc current from the R-2001A to activate the charging circuit. The charging circuit delivers approximately 750 mA of current until the battery voltage reaches 14 volts. As the battery voltage reaches 14 volts, the current drops to approximately 25 mA and the high-charge indicator LED extinguishes.

3.3 When the R-2001 A systems analyzer is used with the RTP-1002A Battery Pack, it is recommended to keep the power switch in the STANDBY position whenever possible. This extends the time the battery is able to operate the R-2001A Communications System Analyzer. The low trickle charge rate enables the batteries to be left on charge indefinitely without damage due to overcharging.

3.4 If long periods of operation from the AC line are anticipated under conditions of high ambient temperature, it is recommended that the RTP-1002A Battery Pack be removed and the blower assembly reinstalled.

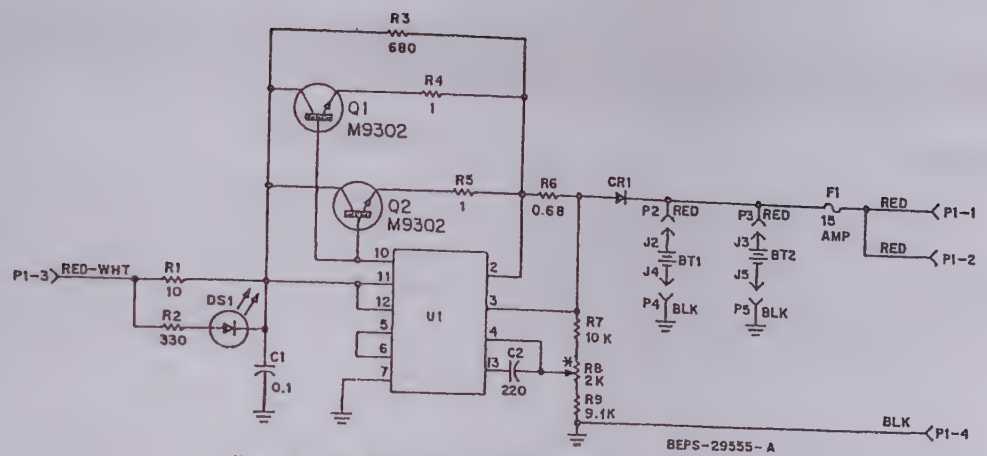



*RTP-1002A Battery Pack Mounting Detail*

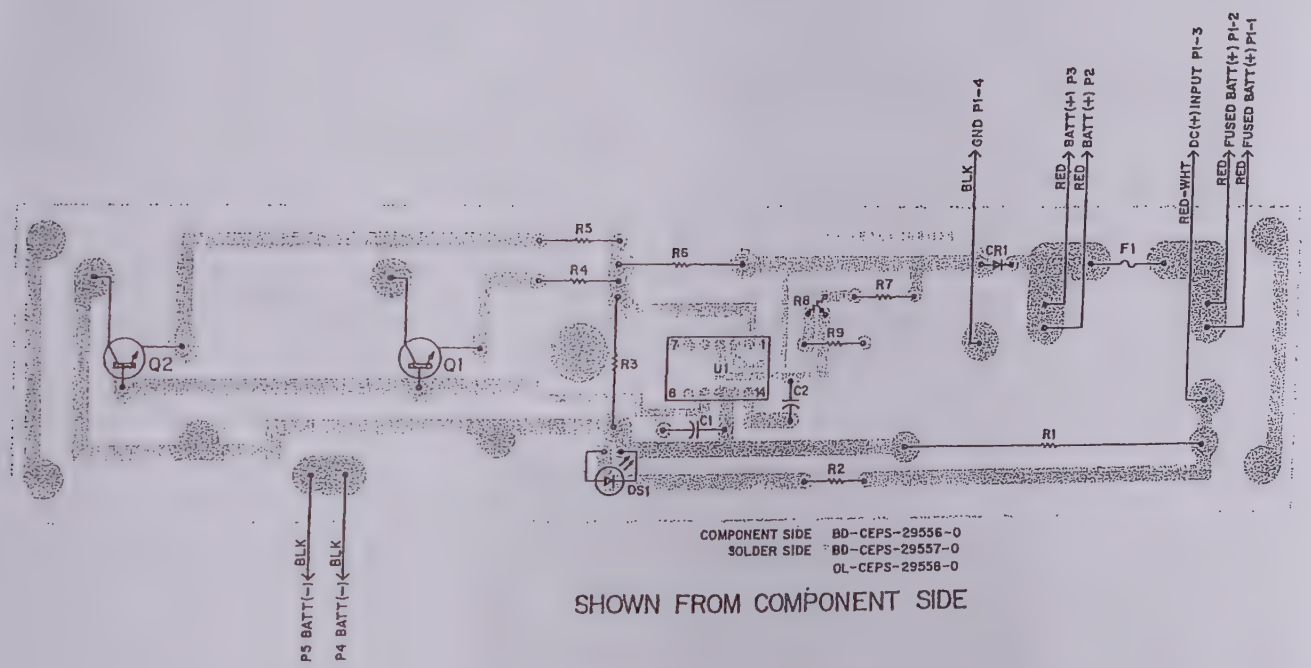
© Motorola, Inc. 1981
All Rights Reserved
Printed in U.S.A.

technical writing services
1301 E. Algonquin Road, Schaumburg, Il. 60196

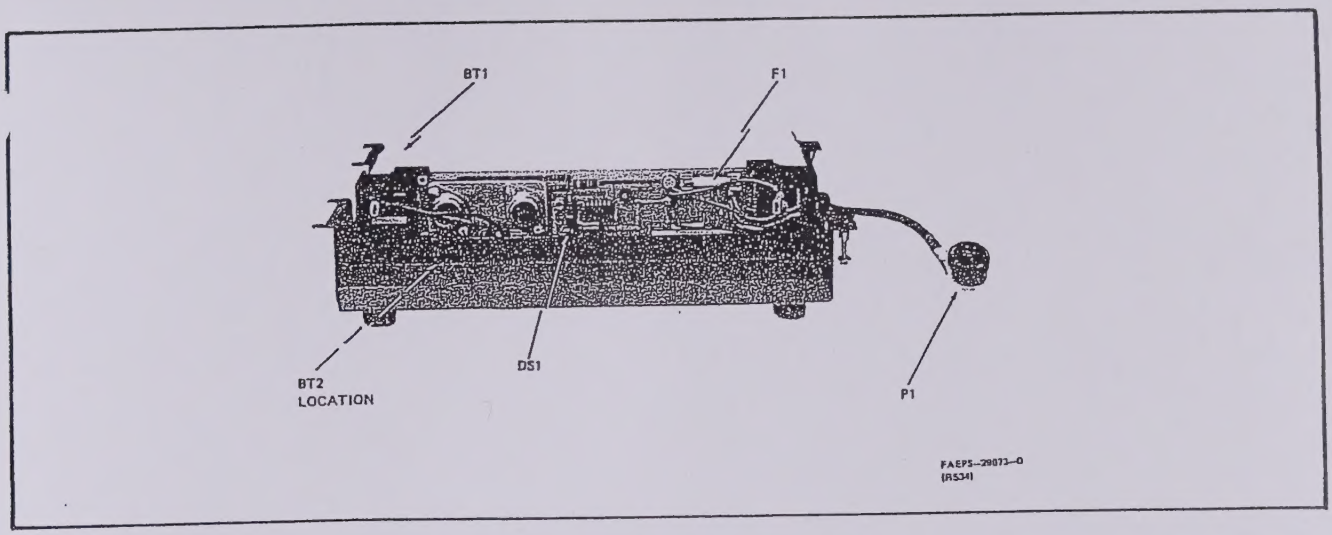
68P81122E59-C
8/30/83-PSP




* WITH THE BATTERIES REMOVED (BT1 AND BT2) AND A 30-OHM; 10 WATT RESISTOR IN PLACE OF THE BATTERIES, SET R8 FOR 14.45V ±50MV USING A DIGITAL VOLTMETER ACROSS THE BATTERY TERMINALS




*RTP-1002A Battery Pack*
*Schematic Diagram, Circuit Board Detail,*
*Parts Location Detail, and Parts List*
*Motorola No. PEPS-29554-A*
*(Sheet 1 of 2)*
*6/29/81-SK*




*RTP-1002A Battery Pack Parts Location Detail*

## parts list

RTP-1002A Battery Pack — PL-6816-A

| REFERENCE SYMBOL | MOTOROLA PART NO. | DESCRIPTION |
|---|---|---|
| | | **battery, 12 V:** |
| BT1, 2 | 60-80340A88 | 6-cell |
| | | **capacitor, fixed:** |
| C1 | 8-82096J18 | .1 uF ± 10%; 250 V |
| C2 | 21-83596E10 | 220 pF ± 20%; 500 V |
| | | **diode: (see note)** |
| CR1 | 48-82525G01 | silicon |
| | | **light emitting diode:** |
| DS1 | 48-82019L05 | LED |
| | | **fuse:** |
| F1 | 65-804906 | 15A slow blow |
| | | **transistor: (see note)** |
| Q1, 2 | 48-869302 | NPN; type M9302 |
| | | **resistor, fixed: ± 10%; 1/4 W: unless otherwise stated** |
| R1 | 17-80344A60 | 10; 10 W |
| R2 | 6-124C37 | 330 |
| R3 | 6-126C45 | 680; 1 W |
| R4, 5 | 6-125B70 | 1 ± 5%; 1/2 W |
| R6 | 17-80344A71 | 0.68 ± 5%; 2 W |
| R7 | 6-124A73 | 10k ± 5% |
| R8 | 18-80342A10 | variable: 2k ± 20%; 1/2 W |
| R9 | 6-124A72 | 9 1k ± 5% |
| | | **integrated circuit: (see note)** |
| U1 | 51-80342A59 | MC1723CL |

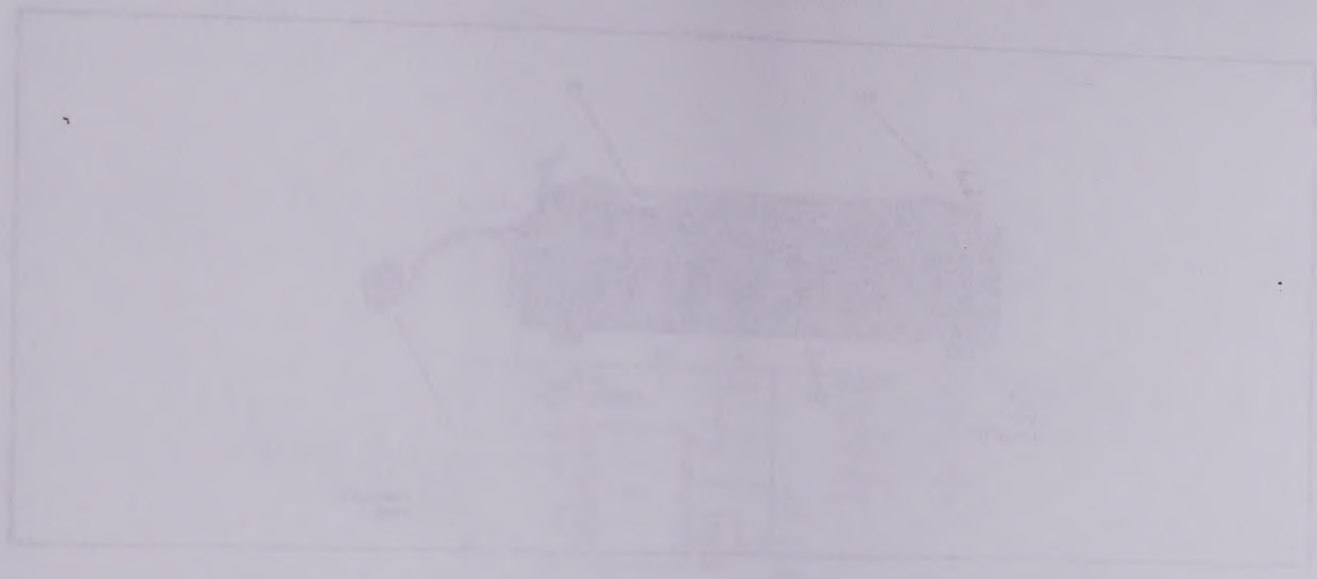
| REFERENCE SYMBOL | MOTOROLA PART NO. | DESCRIPTION |
|---|---|---|
| | | **non-referenced items** |
| | 1-80304A71 | BATTERY CASE includes: |
| | 27-80335A41 | CASE, battery |
| | 3-80340A89 | SCREW, captive: 6-32 x 21/32"; 2 used |
| | 41-80342A53 | SPRING, clip |
| | 15-80340A92 | COVER, battery case |
| | 1-80304A72 | CIRCUIT BOARD ASSEMBLY includes: |
| | 42-82690A01 | CLIP, fuseholder: 2 used |
| | 43-865080 | STANDOFF, threaded: 4 used |
| | 1-80304A73 | LEAD ASSEMBLY, battery (red) includes: |
| | 30-10310A26 | WIRE, No. 16 stranded: 4-1/2" used |
| | 29-859118 | CONTACT, receptacle |
| | 1-80304A74 | LEAD ASSEMBLY, battery (black) includes: |
| | 10-134301 | WIRE, No. 16 stranded: 4-1/2" used |
| | 29-859118 | CONTACT, receptacle |
| | 3-120938 | SCREW, machine: 4-40 x 5/16"; 4 used |
| | 4-7667 | WASHER, lock: No 4 external tooth; 4 used |
| | 64-80342A54 | PLATE, heatsink |
| | 1-80303A91 | CABLE ASSEMBLY includes: |
| | 15-10811A08 | HOUSING, connector: 4-pin |
| | 9-83741F01 | CONTACT, receptacle: 4 used |
| | 42-80340A90 | CLAMP, cable |
| | 2-2888 | NUT, hex: 5/8-24 |
| | 2-7005 | NUT, hex: 6-32; 4 used |
| | 4-7656 | WASHER, lock: No 6 external tooth; 4 used |
| | 14-80340A91 | INSULATOR BOARD |
| | 75-82566B01 | FOOT, rubber: 4 used |
| | 3-80342A46 | SCREW, machine: 6-32 x 1/2"; 4 used |
| | 3-136774 | SCREW, machine: 4-40 x 1/4"; 5 used |
| | 3-132840 | SCREW, machine: 8-32 x 5/8"; 2 used |
| | 4-7667 | WASHER, lock: No 4 external tooth; 5 used |
| | 54-80379A76 | Label Caution |
| | 42-850925 | CLAMP |

note: For optimum performance, replacement diodes, transistors and integrated circuits must be ordered by Motorola part numbers.

**CAUTION**

Do NOT permit battery discharge below 10.4 V dc as indicated on CRT in DVM display mode; immediately turn unit "OFF". Allowing battery discharge below this level may result in permanent damage to the battery. The R-2001 should be plugged into ac power (117/234 V ac) with the power switch in "OFF" or "STANDBY" position to recharge the batteries.

*RTP-1002A Battery Pack*
*Schematic Diagram, Circuit Board Detail,*
*Parts Location Detail, and Parts List*
*Motorola No. PEPS-29554-A*
*(Sheet 2 of 2)*
*6/29/81-SK*



COMMUNICATIONS SYSTEM ANALYZER

MP MASTER
MA22437

68P81069A99-O